PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Investigation Results For
Southwest Minnesota State University

Minnesota STATE COLLEGES & UNIVERSITIES

SOUTHWEST MINNESOTA STATE UNIVERSITY

1/19/2012

Table of Contents

Investigation Report..... Section 1

Southwest Minnesota State University Overview……5

Summary Tables.....6

Facility Overview.....8

Summary of Findings..... Section 2

Findings Details..... Section 3

Findings Details, includes Summary, Details and Investigative Checklist

Bellows Academic Center	(7 pages)
Charter Hall	(8 pages)
Commons East	(4 pages)
Conference Center	(7 pages)
Fine Arts	(7 pages)
Founders Hall	(7 pages)
HA Complex	(4 pages)
Maintenance Building	(4 pages)
Physical Education	(9 pages)
Recreation Athletics Facilities	(6 pages)
Science and Technology	(6 pages)
Social Science	(7 pages)
Student Center	(9 pages)

Southwest Minnesota State University Screening Report.....Section 4

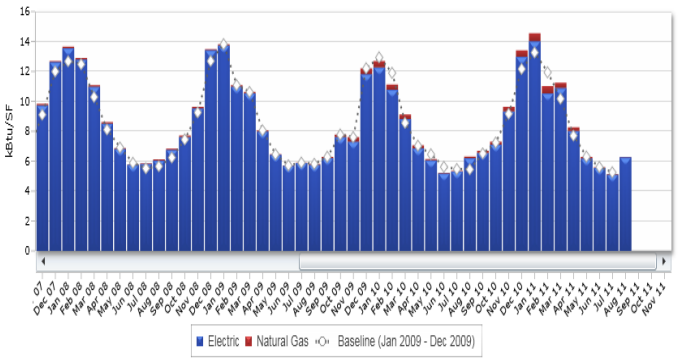
AMEC Screening Report
PBEEEP Deleted Findings
PBEEEP Screening Report

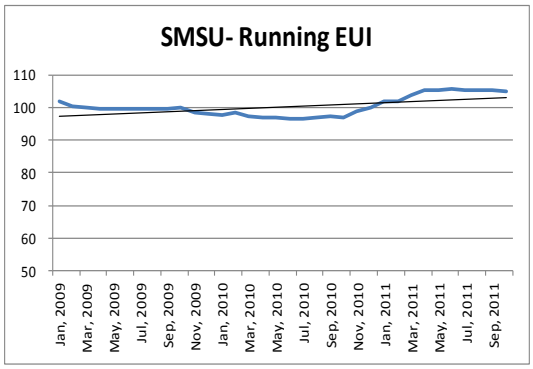
PBEEEP State Government

Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of the Southwest Minnesota State University was performed by AMEC Earth and Environmental, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total Project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$161,510		Total Project Cost	$575,045
Future costs including Implementation , Measurement & Verification	$413,535		Study and Administrative Cost Paid with ARRA Funds	($168,510)
Total Project Cost	$575,045		WAPA Rebates	($0)
			Total costs after co-funding	$406,535
Estimated Annual Total Savings ($)	$144,593		Estimated Annual Total Savings ($)	$144,593
Total Project Payback	4.0		Total Project Payback with co-funding	2.8
Electric Energy Savings	**12.0%**	**and**	**Demand Savings**	**1.8%**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	1,193,036*	120,781,333	120,781,333	0	0%	$1,114,942.18	$0.01
2010	365	1,232,469	123,297,325	121,460,561	1,836,764	2%	$1,274,022.51	$0.01
2011	243	1,232,469	84,236,352	80,932,328	3,304,024	4%	$884,893.71	$0.01

*Listed square footage represents an average for the given year

Southwest MN State University Consumption Report

STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

Facility Name	Southwest Minnesota State University
Location	1501 State Street, Marshall, MN
Facility Manager	Cynthia Holm
Number of Buildings Investigated	13
Interior Square Footage Investigated	787,839
PBEEEP Provider	AMEC Earth and Infrastructure
Study Period	Summer 2010 – Spring 2011
Site Project Manager	Cynthia Holm
Annual Energy Cost	$1,274,023 (2010)
Utility Company	Western Area Power Association for Electric Great Plains Natural Gas Company for Natural Gas
Site Energy Use Index (EUI)	105 kBtu/sq. ft (2010-2011 from B3)
Benchmark EUI (from B3)	142 kBtu/sq. ft

Buildings Investigated:

The thirteen buildings listed below totaling 787,839 interior square feet at SMSU were investigated.

Building Name	State ID	Area (Square Feet)	Year Built
Bellows Academic Center	E26075S0167/1405	177,780	1967/69/05
Charter Hall	E26075S0670	55,618	1970
Commons East	E26075S5670	5,363	1970
Conference Center	E26075S5970	31,989	1970/96/05
Fine Arts	E26075S0268	57,650	1968
Founders Hall	E26075S1073	33,400	1973
HA Complex	E26075S5770	43,167	1970
Maintenance Building	E260750570	12,500	1970/07
Physical Education	E26075S0368	98,764	1968/70
Recreation Athletic Facility	E26075S1295	71,033	1995
Science & Technology	E26075S0470	70,285	1970
Social Science	E26075S1173	53,350	1973
Student Center	E26075S8073	76,940	1970/2005

None of the buildings are sub-metered or metered individually.

Mechanical Equipment Summary Table	
1	Johnson Controls Metasys 4 Automation System
62	Air Handlers
132	Terminal Units
4	Chillers
2	Cooling Towers
8	Electric Hot Water Boilers

Implementation Information			
Estimated Annual Total Savings ($)			$144,593
Total Estimated Implementation Cost ($)			$406,535
GHG Avoided in U.S Tons (CO2e) (assuming standard electric generation in Minnesota, not WAPA's actual delivery)			3,532
Electric Energy Savings (kWh) (2010 Usage 35,181,000 kWh)	12.0% Savings		4,121,453
Electric Demand Savings (Peak kW) (2010 Peak demand was 8,816 kW)	1.8% Savings		157
Statistics			
Number of Measures identified			47
Number of Measures with payback < 3 years			22
Screening Start Date	03/21/2010	Screening End Date	05/19/2010
Investigation Start Date	08/06/2010	Investigation End Date	8/15/2011
Final Report	11/22/2011	Report Presentation	1/23/12

Southwest Minnesota State Part 1 Cost Information			
Phase		**To date**	**Estimated**
Screening		$13,749	
Investigation [Provider]		$119,950	
Investigation [CEE]		$27,811	$1,000
Implementation			$406,535
Implementation [CEE]			$3,000
Measurement & Verification		0	$3,000
Total		$161,510	$413,535

Co-funding Summary	
Study and Administrative Cost	$168,510
Utility Co-Funding - Estimated Total ($)	$0
Total Co-funding ($)	$168,510

SMSU Overview

The energy investigation identified 12% of total energy savings at Southwest Minnesota State University with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Southwest Minnesota State University include adjusting air handler operations to bring in less outside air when spaces are not occupied, utilizing night set backs, and replacing T-12 lighting with more efficient T-8 lighting. The total cost of implementing all the measures is $406,535.
Implementing all these measures can save the facility approximately $144,593 a year, paying back the cost of implementation by energy savings in 2.8 years. Because the study was paid for with ARRA funds the payback is based only on the implementation costs (the study cost is excluded).

During the period of the PBEEEP investigation energy use at Southwest Minnesota State University increased by about 5% compared to the year prior to the study. Implementing the measures identified here will allow SMSU a period of growth without increasing its overall energy consumption. It is now 26% below the benchmark value according to the Minnesota Benchmarking and Beyond database (B3).

The site is made up of twenty-six buildings totaling 1,229,932 interior square feet. There is a single automation system (Johnson Controls Metasys) which controls all the air handling and central plant equipment on the campus. The controls are DDC, but the actuation is mostly pneumatic. Some equipment is only monitored from the BAS. The buildings were all constructed between 1967 and 2009. There have been some major mechanical upgrades during the history of the facility but largely the equipment is original to the buildings. All of the campus is heated, but only twelve of the buildings are cooled.

The school operates year round, but with greatly reduced enrollment during the summer. The Western Area Power Association (WAPA, a federal power agency that distributes hydroelectric power) provides electricity to the campus through one meter and limits the demand the campus can use. During the summer months, the limit is 5MW, and during the winter, it is 10MW. If the campus goes over the limit, they must buy demand and energy from the open market, which is more expensive than WAPA. The campus is almost entirely on electric energy, only Sweetland Hall has natural gas equipment. There are two electric meters and four natural gas meters at SMSU. None of the buildings are sub-metered or metered individually.

The energy investigation included approximately 2/3 of the campus, including 13 buildings. Additional buildings are being investigated in a second study. (These were buildings with major construction projects underway during the period of the first energy investigation).

Findings Summary

Site: Southwest MSU

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Student Center	Over Ventilation.	$732	$6,487	0.11	$0	0.11	158
1	Bellows Academic Center	Outdoor Air Ventilation Provided Overnight	$1,232	$8,923	0.14	$0	0.14	218
2	Physical Education	Over Ventilation.	$1,982	$13,235	0.15	$0	0.15	324
2	Charter Hall	Over Ventilation.	$1,232	$6,723	0.18	$0	0.18	165
2	Founders Hall	Over Ventilation.	$982	$4,937	0.20	$0	0.20	120
2	Recreation Athletics Facilities	Over Ventilation.	$2,714	$10,378	0.26	$0	0.26	253
2	Fine Arts	Over Ventilation.	$1,964	$6,231	0.32	$0	0.32	153
2	Social Science	Over Ventilation.	$982	$2,925	0.34	$0	0.34	71
6	Physical Education	Over Ventilation.	$2,280	$6,033	0.38	$0	0.38	148
5	Recreation Athletics Facilities	Over Ventilation.	$2,000	$4,606	0.43	$0	0.43	112
2	Conference Center	Over Ventilation.	$1,232	$2,814	0.44	$0	0.44	69
1	Recreation Athletics Facilities	No night setback.	$1,384	$3,117	0.44	$0	0.44	76
5	Fine Arts	Over Ventilation.	$1,732	$3,141	0.55	$0	0.55	77
6	Bellows Academic Center	Excessive Ventilation Overnight	$2,232	$2,552	0.87	$0	0.87	62
1	Social Science	No night setback.	$2,024	$2,004	1.01	$0	1.01	49
2	Science and Technology	Over Ventilation.	$2,672	$2,169	1.23	$0	1.23	53
1	Science and Technology	No night setback.	$732	$529	1.38	$0	1.38	13

Findings Summary

Site: Southwest MSU

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
6	Student Center	Over Ventilation.	$3,024	$1,838	1.65	$0	1.65	45
2	Student Center	Night Setback not used.	$4,776	$2,406	1.98	$0	1.98	59
3	Charter Hall	Discharge air temperature resets for both hot deck and cold deck are suboptimal.	$2,512	$1,182	2.12	$0	2.12	29
1	Founders Hall	No night setback.	$2,522	$931	2.71	$0	2.71	23
5	Physical Education	Heat Wheel No Longer Operational	$32,040	$11,662	2.75	$0	2.75	286
3	Bellows Academic Center	AHU Supply Air Fans speeds do not vary sufficiently.	$9,000	$2,923	3.08	$0	3.08	71
2	Bellows Academic Center	Night Setback Not Used.	$5,316	$1,718	3.09	$0	3.09	42
1	Conference Center	Night Setback not used.	$3,418	$1,057	3.23	$0	3.23	26
8	Student Center	Over Ventilation.	$0	$0	3.49	$0	3.49	0
3	Physical Education	Discharge air temperature reset from both Hot deck and cold deck is suboptimal.	$3,012	$754	3.99	$0	3.99	18
3	Student Center	AHU Supply Air and return air fans speeds do not vary sufficiently.	$10,356	$2,502	4.14	$0	4.14	61
1	Physical Education	No night setback.	$5,788	$1,361	4.25	$0	4.25	33
3	Conference Center	Over Ventilation of Conference Rooms When Not in Use	$15,012	$2,958	5.08	$0	5.08	72
1	Charter Hall	No night setback.	$7,650	$1,406	5.44	$0	5.44	34
1	Fine Arts	No night setback.	$5,706	$994	5.74	$0	5.74	24
4	Charter Hall	AHU's operate even when Lecture Halls are empty.	$8,244	$1,314	6.28	$0	6.28	32
3	Social Science	No VAV boxes or VFDs on supply fans. Electric Zone Reheat Coils.	$21,368	$2,909	7.35	$0	7.35	71

Findings Summary

Site: Southwest MSU

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
5	Charter Hall	Magnetic Ballasts with T12 Lamps.	$30,519	$3,286	9.29	$0	9.29	80
3	Science and Technology	Magnetic Ballasts with T12 Lamps.	$20,071	$2,021	9.93	$0	9.93	49
7	Physical Education	Magnetic Ballasts with T12 Lamps.	$17,121	$1,627	10.52	$0	10.52	40
3	Founders Hall	AHU Supply Air Fans do not have VFDs.	$13,768	$1,138	12.10	$0	12.10	28
5	Social Science	Magnetic Ballasts with T12 Lamps.	$11,917	$951	12.53	$0	12.53	23
5	Conference Center	No VFD on supply fans or VAV boxes for multiple zones with electric reheat coils.	$19,304	$1,513	12.76	$0	12.76	37
7	Bellows Academic Center	Magnetic Ballasts with T12 Lamps.	$103,112	$7,997	12.89	$0	12.89	195
5	Student Center	No VFD on Heating water pumps.	$5,826	$439	13.28	$0	13.28	11
1	HA - Dorm	Magnetic Ballasts with T12 Lamps.	$403	$22	17.99	$0	17.99	1
5	Maintenance Building	Magnetic Ballasts with T12 Lamps.	$8,561	$440	19.48	$0	19.48	11
6	Fine Arts	Magnetic Ballasts with T12 Lamps.	$6,005	$225	26.65	$0	26.65	6
1	Commons East	Magnetic Ballasts with T12 Lamps.	$2,076	$67	31.02	$0	31.02	2
5	Founders Hall	Replace HID lights with LEDs	$0	$149	0.00	$0	0.00	4
		Total for Findings with Payback 3 years or less:	**$72,982**	**$104,823**	**0.70**	**$0**	**0.70**	**2,561**
		Total for all Findings:	**$406,535**	**$144,593**	**2.81**	**$0**	**2.81**	**3,532**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Finding Type Number	Finding Type	Found	Looked For, Not Found	Not Relevant	Not Cost Effective
a.1 (1)	Time of Day enabling is excessive	11	1	0	1
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	10	1	2	0
a.3 (3)	Lighting is on more hours than necessary.	12	0	0	1
a.4 (4)	OTHER_Equipment Scheduling/Enabling	11	2	0	0
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	9	1	3	0
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or	9	1	3	0
b.3 (7)	OTHER_Economizer/OA Loads	12	1	0	0
c.1 (8)	Simultaneous Heating and Cooling is present and excessive	6	5	2	0
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	1	12	0	0
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	1	10	2	0
c.4 (11)	OTHER_Controls	13	0	0	0
d.1 (12)	Daylighting controls or occupancy sensors need optimization.	12	0	0	1
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	9	1	2	1
d.3 (14)	Fan Speed Doesn't Vary Sufficiently	6	4	2	1
d.4 (15)	Pump Speed Doesn't Vary Sufficiently	1	5	6	1
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	3	5	4	1
d.6 (17)	Other_Controls (Setpoint Changes)	13	0	0	0
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	3	2	6	2
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	0	1	10	2
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	1	10	2	0
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	12	0	1	0
e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	1	0	12	0
e.6 (22)	Other_Controls (Reset Schedules)	13	0	0	0
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	0	0	0	13
f.2 (24)	Pump Discharge Throttled	1	12	0	0
f.3 (25)	Over-Pumping	0	13	0	0

f.4 (26)	Equipment is oversized for load.	0	2	0	11
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	13	0	0	0
g.1 (28)	VFD Retrofit - Fans	4	2	2	5
g.2 (29)	VFD Retrofit - Pumps	2	4	3	4
g.3 (30)	VFD Retrofit - Motors (process)	0	2	8	3
g.4 (31)	OTHER_VFD	12	0	1	0
h.1 (32)	Retrofit - Motors	13	0	0	0
h.2 (33)	Retrofit - Chillers	1	0	12	0
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	0	0	3	10
h.4 (35)	Retrofit - Boilers	0	0	0	13
h.5 (36)	Retrofit - Packaged Gas fired heating	0	0	13	0
h.6 (37)	Retrofit - Heat Pumps	0	0	0	13
h.7 (38)	Retrofit - Equipment (custom)	0	0	0	13
h.8 (39)	Retrofit - Pumping distribution method	0	0	0	13
h.9 (40)	Retrofit - Energy/Heat Recovery	3	1	9	0
h.10 (41)	Retrofit - System (custom)	0	0	13	0
h.11 (42)	Retrofit - Efficient Lighting	12	0	0	1
h.12 (43)	Retrofit - Building Envelope	0	0	0	13
h.13 (44)	Retrofit - Alternative Energy	0	0	0	13
h.14 (45)	OTHER_Retrofit	0	0	0	13
i.1 (46)	Differed Maintenance from Recommended/Standard	0	0	0	13
i.2 (47)	Impurity/Contamination	0	0	13	0
i.3 ( )	Leaky/Stuck Damper	0	12	1	0
i.4 ( )	Leaky/Stuck Valve	0	13	0	0
i.5 (48)	OTHER_Maintenance	13	0	0	0
j.1 (49)	OTHER	13	0	0	0
	Total	256	123	135	162

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Bellows Academic Center

Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Outdoor Air Ventilation Provided Overnight	$1,232	$8,923	0.14	$0	0.14	218
6	Excessive Ventilation Overnight	$2,232	$2,552	0.87	$0	0.87	62
3	AHU Supply Air Fans speeds do not vary sufficiently.	$9,000	$2,923	3.08	$0	3.08	71
2	Night Setback Not Used.	$5,316	$1,718	3.09	$0	3.09	42
7	Magnetic Ballasts with T12 Lamps.	$103,112	$7,997	12.89	$0	12.89	195
	Total for Findings with Payback 3 years or less:	**$3,464**	**$11,475**	**0.30**	**$0**	**0.30**	**280**
	Total for all Findings:	**$120,892**	**$24,114**	**5.01**	**$0**	**5.01**	**588**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Bellows Academic Center

FWB Number:	10101	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Outdoor Air Ventilation Provided Overnight	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night for AHU-2,3,4,5.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHUs remains open at night and visual inspection.		
Measure:	Program outdoor air dampers to remain closed overnight..		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am (or possibly as late as 8am). 1) Reprogram schedule for AHU-2. 2) Reprogram schedule for AHU-3, 3) Reprogram schedule for AHU-4. 4) Reprogram schedule for AHU-5.		
Evidence of Implementation Method:	Trend OA Damper position, RAT, MAT, DAT and mixed air on AHU-2, 3, 4 and 5 over at least one week of time when the system needs to cycle overnight to meet the (setback) temperature setpoint (e.g. outside temperature below 30Â°F). Confirm that the OA damper position is closed overnight and that the MAT nearly matches the RAT (and is unaffected by OAT) during overnight (11pm to 6am) HVAC unit cycles.		

Annual Electric Savings (kWh):	253,845	Contractor Cost ($):	$1,000
Estimated Annual kWh Savings ($):	$8,923	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$1,232

Estimated Annual Total Savings ($):	$8,923	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.14	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.14	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	218	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	5.5%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Bellows Academic Center

FWB Number:	10101	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Night Setback Not Used.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night because of concerns about high morning electric heating demand peaks which may result in overrunning the electricity allotment. This is for AHU-1 through AHU-5 and all associated zones.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Set space temperatures back by 5F at night with staggered morning restart.		
Recommendation for Implementation:	Provide night setback with staggered restart for AHU-1 through AHU-5 and associated zones. Provider shall develop a campus wide master morning restart time plan that will provide the basis for the following: 1) Reprogram set point schedule for AHU's 1 through 5 to provide a 5Â°F setback from 11pm to various staggered restart times based on campus wide coordination 2) Reprogram set points for (64) VAV boxes to match the associated AHU schedule per 1). Note: This scope does not include the fan coil units because changing all of the existing single setpoint pneumatic thermostats becomes cost prohibitive.		
Evidence of Implementation Method:	Trend multiple zone temperatures to make sure they drop at night. For each air handler, the following shall be trended for at least one week during the heating season (outdoor temperaures below 40Â°F at night) and one week during the cooling season (outdoor temperatures above 70Â°F at night): MAT, DAT, fan status, no less than 20% of zone temperatures and (where present) no less than 20% of VAV box damper positions and outlet temperature. Confirm that after 11 pm heating is only provided after temperatures drift down by 5Â°F, and that cooling is only provided after temperatures drift up by 5Â°F. Refer to master morning restart time plan for verificaiton of the appropriate end times for the overnight setback periods.		

Annual Electric Savings (kWh):	48,885	Contractor Cost ($):	$4,736
Estimated Annual kWh Savings ($):	$1,718	PBEEEP Provider Cost for Implementation Assistance ($):	$580
		Total Estimated Implementation Cost ($):	$5,316

Estimated Annual Total Savings ($):	$1,718	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.09	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.09	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	42	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.1%	Percent of Implementation Costs:	0.6%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Bellows Academic Center

FWB Number:	10101	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Supply Air Fans speeds do not vary sufficiently.	Date Identified:	9/10/2010
Description of Finding:	VAV system fans operate at high speed (close to 60 Hz) even when many VAV boxes are in heating mode. AHU-2,3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Fan Speed Doesn't Vary Sufficiently		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Visual inspection of the VFD speed. Trend the SF speed over time.		
Measure:	Perform detailed verification and corrections to VAV boxes and air handler control for AHU-2 and 3.		
Recommendation for Implementation:	For AHU-2 and 3 perform the following control verification and deficiency correction: 1) Perform detailed VAV box modulation verification and deficiency correction for (33) VAV boxes associated with AHU-2 and 3. 2) Verify static pressure set point is appropriate by confirming that a sampling of 10-20% of zones have design flow when VAV boxes are fully open. 3) Perform detailed supply fan VFD control program review to confirm that the logic properly modulates speed to maintain the constant duct static pressure setpoint (and modify as needed). 4) Verify AHU discharge air temperature reset programming maintains set point between 55 and 60Â°F appropriately for the season.		
Evidence of Implementation Method:	For each air handler trend the following over at least one week in summer and one week in winter: supply fan speed, static pressure, static pressure setpoint, DAT and DAT sepoint (plus VAV box flow setpoint, flow and damper position where possible). Confirm that the supply fan speed varies between 50-80% speed under most conditions, that the duct static pressure setpoint is met, and that the DAT appropriately varies between 55 and 60Â°F.		

Annual Electric Savings (kWh):	83,164	Contractor Cost ($):	$7,840
Estimated Annual kWh Savings ($):	$2,923	PBEEEP Provider Cost for Implementation Assistance ($):	$1,160
		Total Estimated Implementation Cost ($):	$9,000

Estimated Annual Total Savings ($):	$2,923	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.08	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.08	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	71	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.8%	Percent of Implementation Costs:	1.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Bellows Academic Center

FWB Number:	10101	Eco Number:	6
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Excessive Ventilation Overnight	Date Identified:	9/10/2010
Description of Finding:	The 100% outdoor air units (BAH1 and AHU-6) operate at night when they are not needed.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends and visual inspection of the SF Status over time.		
Measure:	Schedule 100% outdoor air units to shut down at night.		
Recommendation for Implementation:	Schedule each 100% outside air unit to shut down between 11pm and 6am (or perhaps as late as 8am). 1) Reprogram schedule for BAH1. 2) Reprogram schedule for AHU6. 3) Note: These should be completely shut down at night as they do not affect temperature set points.		
Evidence of Implementation Method:	Trend supply fan status, OAT and DAT for BAH1 and AHU-6 for at least one week to confirm that these units shut down overnight.		

Annual Electric Savings (kWh):	72,608	Contractor Cost ($):	$2,000
Estimated Annual kWh Savings ($):	$2,552	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$2,232

Estimated Annual Total Savings ($):	$2,552	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.87	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.87	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	62	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.6%	Percent of Implementation Costs:	0.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Bellows Academic Center

FWB Number:	10101	Eco Number:	7
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. These use much more energy than newer fluorescent lighting options. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visual inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low wattage (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts within the existing described lighting fixtures. 2LT12 8' with 4LT8 25W HBF 8' (29); 3LT12 8' with 4LT8 25W HBF 8' (50); 2LT12 4' with 2LT8 25W NBF (1200); 3LT12 4' with 2LT8 25W NBF (165); 4LT12 4' with 4LT8 25W NBF (67)		
Evidence of Implementation Method:	Visually inspect a sample of fixtures and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	227,519	Peak Demand Savings (kWh):	68
Estimated Annual kWh Savings ($):	$7,997	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$96,152		
PBEEEP Provider Cost for Implementation Assistance ($):	$6,960		
Total Estimated Implementation Cost ($):	$103,112		

Estimated Annual Total Savings ($):	$7,997	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	12.89	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	12.89	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	195	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.9%	Percent of Implementation Costs:	12.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10101 - SMSU - Bellows Academic Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AHU Room's		Verify scheduling of all AHUs. Screenshots.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used
	a.3 (3)	Lighting is on more hours than necessary.	X	Throughout Building		Lights were left on, no occupancy sensors were installed in corridors and classsrooms.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	HVAC Economizer		Verify that economizer is working. Trend signal. Physically check damper positions.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	HVAC Equipment		Verify OA damper closes at night. Trend - physically spot check.
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Throughout Building		Lights were left, no occupancy sensors were installed in corridors and classsrooms.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	X	AHU2, AHU3, AHU4		pressure sensor, review VAV box positions, and VAV box control strategy.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	X	AHU2, AHU3, AHU4		Spot check VAV box positions
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	X			Trend boiler HWS temperature
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)	X	Mechanical Room		Heat wheel in West mechanical room not operational
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	X	EF2, EF3		Review EF-2 and EF-3 control. VFDs at 20 and 33 hz
	g.1 (28)	VFD Retrofit - Fans			Not Relevant	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10101 - SMSU - Bellows Academic Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery	X	AHU1, AHU6		Heat wheels are approximately 40 years old. Effectiveness is not currently known.
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance	X			Is steam humidity boiler operational?
j. OTHER	j.1 (49)	OTHER	X			Look at Fan coil units near rooms 204, 206, 207

Findings Summary

Building: Charter Hall
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over Ventilation.	$1,232	$6,723	0.18	$0	0.18	165
3	Discharge air temperature resets for both hot deck and cold deck are suboptimal.	$2,512	$1,182	2.12	$0	2.12	29
1	No night setback.	$7,650	$1,406	5.44	$0	5.44	34
4	AHU's operate even when Lecture Halls are empty.	$8,244	$1,314	6.28	$0	6.28	32
5	Magnetic Ballasts with T12 Lamps.	$30,519	$3,286	9.29	$0	9.29	80
	Total for Findings with Payback 3 years or less:	**$3,744**	**$7,905**	**0.47**	**$0**	**0.47**	**194**
	Total for all Findings:	**$50,157**	**$13,910**	**3.61**	**$0**	**3.61**	**341**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Charter Hall

FWB Number:	10102	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. C-AH1 through C-AH4.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram set point schedule for (4) AHU's. 2) Add (4) DDC night setback thermostats for each dual duct AHU and (1) night setback thermostat/sensor for each Lecture Hall AHU, to override daytime controls and shut unit down at night except when the night set points are reached for any of the mulitple stats or sensors per AHU. 3) Program setpoints with setbacks for all (4) AHU's and (10) zones.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	40,164	Contractor Cost ($):	$6,722
Estimated Annual kWh Savings ($):	$1,406	PBEEEP Provider Cost for Implementation Assistance ($):	$928
		Total Estimated Implementation Cost ($):	$7,650

Estimated Annual Total Savings ($):	$1,406	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	5.44	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	5.44	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	34	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.9%	Percent of Implementation Costs:	0.9%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Charter Hall

FWB Number:	10102	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. C-AH1 through C-AH4. Trending data for OA Damper shows it only opens when economizer on, otherwise 0%. However, there is a separate Minimum OA damper which was open on C-AH-1 and 2 upon visual inspection.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends and visual inspection of the EMCS. See screenshots in CH Trend file.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram schedule for C-AH-1. 2) Reprogram schedule for C-AH-2, 3) Reprogram schedule for C-AH-3. 4) Reprogram schedule for C-AH-4.		
Evidence of Implementation Method:	Trend OA Damper position over time. Visual inspection of OA damper during night hours.		

Annual Electric Savings (kWh):	192,087	Contractor Cost ($):	$1,000
Estimated Annual kWh Savings ($):	$6,723	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$1,232

Estimated Annual Total Savings ($):	$6,723	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.18	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.18	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	165	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.1%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Charter Hall

FWB Number:	10102	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Discharge air temperature resets for both hot deck and cold deck are suboptimal.	Date Identified:	9/10/2010
Description of Finding:	Hot deck and cold deck temps are sometimes as much as 35F apart. C-AH1 and C-AH2.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of Hot and Cold Deck vs. Time, visual thermometer readings, and manual temperature measurements.		
Measure:	Limit difference between hot deck and cold deck to 25F.		
Recommendation for Implementation:	Program minimum and maximum cold deck and hot deck temperatures for C-AH1 and C-AH2. 1) Maintain existing HD CD temperature set point programming except for the addition of the following min and max setpoints: a) If OAT is less than 0ËšF provide maximum HD temp of 90ËšF and minimum CD temp of 65Ëš. b) If the OAT is between 0ËšF and 55ËšF provide maximum HD temp of 85ËšF and minimum CD temp of 60Ëš. c) If the OAT is between 55ËšF and 75ËšF provide maximum HD temp of 80ËšF and minimum CD temp of 55Ëš. d) If OAT is greater than 75ËšF provide maximum HD temp of 75ËšF and minimum CD temp of 50Ëš.		
Evidence of Implementation Method:	For each unit, trend OAT, hot deck DAT, cold deck DAT for at least one week in each of the three seasons (summer, winter and shoulder). Confirm that for each outside tempreature range noted in the "Recommendation for Implementation" both the hot deck and cold deck temperatures stay within the intended limits.		

Annual Electric Savings (kWh):	33,780	Contractor Cost ($):	$2,048
Estimated Annual kWh Savings ($):	$1,182	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$2,512

Estimated Annual Total Savings ($):	$1,182	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.12	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.12	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	29	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.7%	Percent of Implementation Costs:	0.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Charter Hall

FWB Number:	10102	Eco Number:	4
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	AHU's operate even when Lecture Halls are empty.	Date Identified:	9/10/2010
Description of Finding:	Constant volume C-AH3 and C-AH4 both continue to operate at full speed and ventilation when Lecture Halls are unoccupied.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends, visual inspection of the units. Interviews with building staff on normal hours of operation.		
Measure:	Install CO2 sensors.		
Recommendation for Implementation:	Install CO2 sensors in the Lecture Halls so the AHU's only operate at full speed and with full ventilation when necessary. 1) Provide (4) CO2 sensors 2) Provide DDC CO2 controller - set point to be 1000 ppm 3) Provide programming to modulate OA dampers based upon CO2 sensor reading.		
Evidence of Implementation Method:	Set up a trend of the CO2 levels and OA damper position over time. Ensure that CO2 levels are maintained near setpoint (1000 ppm) and that OA damper is reacting to CO2 level appropriately.		

Annual Electric Savings (kWh):	37,534	Contractor Cost ($):	$7,316
Estimated Annual kWh Savings ($):	$1,314	PBEEEP Provider Cost for Implementation Assistance ($):	$928
		Total Estimated Implementation Cost ($):	$8,244

Estimated Annual Total Savings ($):	$1,314	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	6.28	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	6.28	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	32	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.8%	Percent of Implementation Costs:	1.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Charter Hall

FWB Number:	10102	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 1LT12 4' with 1LT8 25W NBF (36) 2LT12 4' with 2LT8 25W NBF (33) 3LT12 4' with 2LT8 25W NBF (294) 4LT12 4' with 4LT8 25W NBF (89)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	93,875	Peak Demand Savings (kWh):	30
Estimated Annual kWh Savings ($):	$3,286	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$28,199		
PBEEEP Provider Cost for Implementation Assistance ($):	$2,320		
Total Estimated Implementation Cost ($):	$30,519		

Estimated Annual Total Savings ($):	$3,286	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	9.29	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	9.29	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	80	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.0%	Percent of Implementation Costs:	3.6%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10102 - SMSU - Charter Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AH1, AH2, AH3, AH4		Verify AH1 through AH4 schedules, screenshots
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used.
	a.3 (3)	Lighting is on more hours than necessary.	X	Throughout Building		Lights were left, no occupancy sensors were installed in corridors and classsrooms.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	HVAC Economizer		Review economizer set point and mixed air low limit, verify economizer operation.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	HVAC Equipment		Does minimum outside air damper close for AH3 and AH4 when Lecture hall is empty? Trend MOAD position and Occupied Ctrl.
	b.3 (7)	OTHER_Economizer/OA Loads	X	HVAC Equipment		Does minimum outside air damper close at night? Trend MOAD position.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X	AH1, AH2		Trend hot deck and cold deck temps on AH1 and AH2
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Throughout Building		Lights were left, no occupancy sensors were installed in corridors and classsrooms.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)	X	AH3, AH4		Can fans stop or slow down when Lecture halls are unoccupied? Use VFD's?
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans	X	AH3, AH4		Can fans stop or slow down when Lecture halls are unoccupied? Use VFD's?

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10102 - SMSU - Charter Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Investigation looked for, but did not find this issue.	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Not Relevant	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Findings Summary

Building: Commons East
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Magnetic Ballasts with T12 Lamps.	$2,076	$67	31.02	$0	31.02	2
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$2,076**	**$67**	**31.02**	**$0**	**31.02**	**2**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Commons East

FWB Number:	10103	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 2LT12 4' with 2LT8 25W NBF (20)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	1,912	Peak Demand Savings (kWh):	1
Estimated Annual kWh Savings ($):	$67	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$1,148		
PBEEEP Provider Cost for Implementation Assistance ($):	$928		
Total Estimated Implementation Cost ($):	$2,076		

Estimated Annual Total Savings ($):	$67	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	31.02	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	31.02	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	2	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10103 - SMSU - Commons East

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X			Requires 24/7 operation for heating. Does fan cycle off? At night?
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Not Relevant	
	a.3 (3)	Lighting is on more hours than necessary.	X	Lounge, Common Areas		Lights left on, no occupancy sensors in building.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Not Relevant	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Not Relevant	
	b.3 (7)	OTHER_Economizer/OA Loads	X			Review OA damper operation, what is optimal? Is OA damper manually changed from summer to winter?
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Not Relevant	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Not Relevant	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Lounge, Common Areas		Lights left on, no occupancy sensors in building.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Not Relevant	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Not Relevant	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not cost-effective to investigate	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not cost-effective to investigate	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans			Not cost-effective to investigate	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10103 - SMSU - Commons East

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not cost-effective to investigate	
	g.3 (30)	VFD Retrofit - Motors (process)			Not cost-effective to investigate	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Lounge, Common Areas		T12 lamps with magnetic ballests were observed.
	h.12 (43)	Retrofit - Building Envelope	X		Not cost-effective to investigate	Single pane windows with storms/screens. Observe how many windows open.
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Findings Summary

Building: Conference Center
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over Ventilation.	$1,232	$2,814	0.44	$0	0.44	69
1	Night Setback not used.	$3,418	$1,057	3.23	$0	3.23	26
3	Over Ventilation of Conference Rooms When Not in Use	$15,012	$2,958	5.08	$0	5.08	72
5	No VFD on supply fans or VAV boxes for multiple zones with electric reheat coils.	$19,304	$1,513	12.76	$0	12.76	37
	Total for Findings with Payback 3 years or less:	**$1,232**	**$2,814**	**0.44**	**$0**	**0.44**	**69**
	Total for all Findings:	**$38,966**	**$8,342**	**4.67**	**$0**	**4.67**	**203**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Conference Center

FWB Number:	10104	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Night Setback not used.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. AHU-1 through AHU-4.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram set point schedule for (4) AHU's. 2) Replace all (10) Reheat Coil thermostats with programmable. (10 units) 4) Program setpoints with setbacks for all (10) Reheat Coils.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	30,077	Contractor Cost ($):	$2,954
Estimated Annual kWh Savings ($):	$1,057	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$3,418

Estimated Annual Total Savings ($):	$1,057	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.23	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.23	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	26	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	0.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Conference Center

FWB Number:	10104	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. AHU-1,2,3,4.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU1 remains open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram schedule for AHU-1. 2) Reprogram schedule for AHU-2, 3) Reprogram schedule for AHU-3. 4) Reprogram schedule for AHU-4.		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	80,067	Contractor Cost ($):	$1,000
Estimated Annual kWh Savings ($):	$2,814	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$1,232

Estimated Annual Total Savings ($):	$2,814	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.44	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.44	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	69	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.7%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Conference Center

FWB Number:	10104	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation of Conference Rooms When Not in Use	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open when conference rooms are empty. AHU-1,2,3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU1,2,3 remains open during times when conference rooms are empty and visual inspection.		
Measure:	Add CO2 Sensor Control to Reduce Outside Air When Rooms are Empty.		
Recommendation for Implementation:	Install CO2 sensors in each Conference Room such that rooms receive outdoor ventilation only when necessary. 1) Provide (10) CO2 sensors 2) Provide DDC CO2 controllers 3) Provide programming to modulate (3) AHU OA dampers to maintain maximum CO2 sensor readings of 1,000 ppm while maintaining a reduced minimum outdoor air damper position based on the Area Outdoor Air Rate in ASHRAE Standard 62.1.		
Evidence of Implementation Method:	For each air handler (AHU1,2,3), trend the following for a period of at least one week when the outdoor air temperature is primarily either below 40Â°F or above 70Â°F for the majority of the time (to avoid economizer operation periods): CO2 levels, OA damper position, OAT, RAT, MAT, and SF status. Compare the above trend data against the building's schedule of conference room usage to verify that CO2 levels are maintained near setpoint (1000 ppm) and that OA dampers are reacting to CO2 levels appropriately.		

Annual Electric Savings (kWh):	84,145	Contractor Cost ($):	$13,156
Estimated Annual kWh Savings ($):	$2,958	PBEEEP Provider Cost for Implementation Assistance ($):	$1,856
		Total Estimated Implementation Cost ($):	$15,012

Estimated Annual Total Savings ($):	$2,958	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	5.08	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	5.08	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	72	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.8%	Percent of Implementation Costs:	1.8%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Conference Center

FWB Number:	10104	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No VFD on supply fans or VAV boxes for multiple zones with electric reheat coils.	Date Identified:	9/10/2010
Description of Finding:	No VFD on supply fans or VAV boxes for multiple zones with electric reheat coils. Constant Volume systems AHU-1,2,3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Fans		

Implementer:	Mechanical Contractor/ Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Visualy verified there were no VFD's, looked at trends to determine they are constant volume fans, visual inspection of mechanical drawings.		
Measure:	Install VFD's.		
Recommendation for Implementation:	Install VFD's on the fans for AHU1,2,3 so they can control the fan output based on the required load. 1) Provide controls to set discharge air temperature to constant 55F set point during cooling season and 60F during heating season (adjustable). 2) Provide discharge air temperature during winter as high as possible by sampling zones, if any are too warm then adjust AHU DAT down and vice versa. 3) Provide VFD on (3) supply fans AHU's 1,2,3. (20hp + 7.5 hp + 5 hp) 4) Provide controls to vary the fan speed for each AHU based on zone temperature(s) during cooling season. If all zones are satisfied then slow the fan speed. 5) Provide controls to set heating season supply fan speed at 70-80%. Note: AHU and Zone Electric Heating coils will need to see a minimum air flow in order to operate properly, dropping AHU fan speed below 70% may cause coils to lose power.		
Evidence of Implementation Method:	Visually verify that VFD's are installed, trend VFD command over time to ensure it is properly working according to Recommendations.		

Annual Electric Savings (kWh):	43,036	Contractor Cost ($):	$17,448
Estimated Annual kWh Savings ($):	$1,513	PBEEEP Provider Cost for Implementation Assistance ($):	$1,856
		Total Estimated Implementation Cost ($):	$19,304

Estimated Annual Total Savings ($):	$1,513	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	12.76	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	12.76	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	37	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.9%	Percent of Implementation Costs:	2.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10104 - SMSU - Conference Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AHU1, AHU2, AHU3, AHU4		Verify scheduling with screen shot (AHU-1 thru AHU-4)
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used.
	a.3 (3)	Lighting is on more hours than necessary.	X	Throughout Building		Have dedicated computer for this, but curently not utilizing its capabilities.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AHU1, AHU2, AHU3, AHU4		Economizer does not operate properly, trend OA and RA damper positions. Check minimum mixed air set point
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	AHU1, AHU2, AHU3		Suspect conference rooms are not occupied much of the time yet are fully ventilated. Trend OA damper position, or CO2 (if available), and verify useage of conference rooms.
	b.3 (7)	OTHER_Economizer/OA Loads	X	AHU1, AHU2, AHU3, AHU4		Suspect OA dampers are open during nightime unoccupied periods. Trend OA damper position, verify nightime position
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls	X	AHU1, AHU2, AHU3		Model using modulating dampers or VAV boxes with VFD's on fans
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Throughout Building		Have dedicated computer for this, but curently not utilizing its capabilities.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Do not want night setback
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	X	AHU1, AHU2, AHU3		Fans are constant volume
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	No VAV boxes
	d.6 (17)	Other_Controls (Setpoint Changes)	X	EF1, EF2		Verify EF's 1 and 2 operate properly according to building pressure. Trend building p
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans	X	AHU1, AHU2, AHU3, AHU4		Potential for retrofit of all AHU's to VAV.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10104 - SMSU - Conference Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	
	g.3 (30)	VFD Retrofit - Motors (process)			Investigation looked for, but did not find this issue.	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Not cost-effective to investigate	
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

ressure and fan speed. Verify location and size.

Findings Summary

PBEEEP State Government

Building: Fine Arts
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over Ventilation.	$1,964	$6,231	0.32	$0	0.32	153
5	Over Ventilation.	$1,732	$3,141	0.55	$0	0.55	77
1	No night setback.	$5,706	$994	5.74	$0	5.74	24
6	Magnetic Ballasts with T12 Lamps.	$6,005	$225	26.65	$0	26.65	6
	Total for Findings with Payback 3 years or less:	**$3,696**	**$9,372**	**0.39**	**$0**	**0.39**	**229**
	Total for all Findings:	**$15,407**	**$10,591**	**1.45**	**$0**	**1.45**	**259**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Fine Arts

FWB Number:	10105	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. FA-AH1 through FA-AH7.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram set point schedule for (7) Multizone AHU's. 2) Provide night setback temperature sensors for each AHU. 3) Modify DDC programming to provide night setback.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	28,392	Contractor Cost ($):	$5,242
Estimated Annual kWh Savings ($):	$994	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$5,706

Estimated Annual Total Savings ($):	$994	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	5.74	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	5.74	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	24	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	0.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Fine Arts

FWB Number:	10105	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. FA-AH1 through FA-AH5, and FA-AH7. Trending data for OA Damper shows it stays open 10% even in middle of night.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU1 remains open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram damper open/close schedule for FA-AH1, FA-AH2, FA-AH3, FA-AH4, FA-AH-5, and FA-AH-7. 2).		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	178,043	Contractor Cost ($):	$1,500
Estimated Annual kWh Savings ($):	$6,231	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$1,964

Estimated Annual Total Savings ($):	$6,231	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.32	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.32	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	153	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.8%	Percent of Implementation Costs:	0.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Fine Arts

FWB Number:	10105	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	FA-AH-6 (A 100% OA unit with heat wheel) continues to operate at night.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of the SF Command and OA Damper position show they do not turn off at night.		
Measure:	Schedule heat wheel and FA-AHU-6 to shut down at night.		
Recommendation for Implementation:	Schedule the unit to shut down between 11pm and 6am. 1) Provide programming to ensure supply and exhaust fans shut down, heating coil shuts down, and outdoor air damper closes at night.		
Evidence of Implementation Method:	Trend the SF Command and OA Damper position show they are working properly and shutting down during the night/unoccupied hours.		

Annual Electric Savings (kWh):	89,737	Contractor Cost ($):	$1,500
Estimated Annual kWh Savings ($):	$3,141	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$1,732

Estimated Annual Total Savings ($):	$3,141	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.55	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.55	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	77	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.9%	Percent of Implementation Costs:	0.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Fine Arts

FWB Number:	10105	Eco Number:	6
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 2LT12 4' with 2LT8 25W NBF (66) 3LT12 4' with 2LT8 25W NBF (6)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	6,438	Peak Demand Savings (kWh):	3
Estimated Annual kWh Savings ($):	$225	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$4,149		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,856		
Total Estimated Implementation Cost ($):	$6,005		

Estimated Annual Total Savings ($):	$225	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	26.65	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	26.65	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	6	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.1%	Percent of Implementation Costs:	0.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10105 - SMSU - Fine Arts

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	Throughout Building		Verify Scheduling, screenshots, all (7) AHUs.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used.
	a.3 (3)	Lighting is on more hours than necessary.	X	Corridors and Classrooms		Lights on in unoccupied areas, no occupancy sensors in hallways and classrooms.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	HVAC Equipment		Trend Economizer operation, verify damper operation.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	AH1, AH2, AH3, AH4, AH5, AH7		Check OA damper position day and night, Set up trend.
	b.3 (7)	OTHER_Economizer/OA Loads	X	AH1, AH2, AH3, AH4, AH5, AH7		Trend OA damper on all units, verify operation. Does it close at night?
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X	AH5, AH7		Trend hot deck and cold deck temps. Can they be reset?
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		Investigation looked for, but did not find this issue.		
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints		Investigation looked for, but did not find this issue.		
	c.4 (11)	OTHER_Controls	X			Observe zone damper operation on multizone units.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Corridors and Classrooms		Lights on in unoccupied areas, no occupancy sensors in hallways and classrooms.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	X			Check /Trend Boiler modulation and screenshoot reset schedule.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	X			Trend chw coil valve and hw coil valve.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	X	AH6		Heat wheel not in operation - RA door open.
	g.1 (28)	VFD Retrofit - Fans			Not cost-effective to investigate	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10105 - SMSU - Fine Arts

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not cost-effective to investigate	
	g.3 (30)	VFD Retrofit - Motors (process)			Not cost-effective to investigate	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery	X	AH6		Heat wheel not in operation - RA door open.
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Corridors and Classrooms		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER	X	AH7		See AHU-7 in mech rm B156.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. FH-AH1 through FH-AH3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram set point schedule for (3) AHU's. 2) Add master night setback T-stat for each AHU (3) 3) Program setpoints with setbacks for each unit.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	26,497	Contractor Cost ($):	$2,058
Estimated Annual kWh Savings ($):	$931	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$2,522

Estimated Annual Total Savings ($):	$931	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.71	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.71	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	23	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	0.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. FH-AH1 through FH-AH3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU1 remains open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram outdoor air damper open/close schedule for FH-AH1. 2) Reprogram schedule for FH-AH2, 3) Reprogram schedule for FH-AH3.		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	140,451	Contractor Cost ($):	$750
Estimated Annual kWh Savings ($):	$4,937	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$982

Estimated Annual Total Savings ($):	$4,937	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.20	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.20	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	120	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.0%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Supply Air Fans do not have VFDs.	Date Identified:	9/10/2010
Description of Finding:	VAV system fans operate at constant speed even though system has VAV boxes. Pneumatic VAVs are bypass type. (VAV box info not on EMCS).		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Fans		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Photos of bypass boxes. Electric baseboard heat is manually controlled. VAV boxes are pneumatic and are not interlocked with electric baseboard.		
Measure:	Add VFDs to (3) AHU supply fans.		
Recommendation for Implementation:	1) Add VFDs to supply fan motors of 10, 10, and 15 hp. 2) Program VFD operation using Return air temperature in summer and by using 70% flow in winter. Summer - Increase SF speed if RA temperature rises above 78F, decrease speed if RA temperature drops below 75F. (Bypass style boxes will cool the return air plenum if in bypass mode.) Calculate current outside air requirements per ASHRAE and re-balance minimum outside air dampers to provide code required fresh air in the winter (70% fan speed).		
Evidence of Implementation Method:	Trend VFD Speed and Return air temperature over time in summer and winter.		

Annual Electric Savings (kWh):	32,362	Contractor Cost ($):	$12,840
Estimated Annual kWh Savings ($):	$1,138	PBEEEP Provider Cost for Implementation Assistance ($):	$928
		Total Estimated Implementation Cost ($):	$13,768

Estimated Annual Total Savings ($):	$1,138	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	12.10	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	12.10	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	28	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.7%	Percent of Implementation Costs:	1.6%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Replace HID lights with LEDs	Date Identified:	9/10/2010
Description of Finding:	14 HID fixtures was replaced with LED lighting in the Summer of 2011.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install LED Lights		
Recommendation for Implementation:	Replace all HID HPS Lights throughout the building with LED Lights. Already done this last summer.		
Evidence of Implementation Method:	Done.		

Annual Electric Savings (kWh):	4,233	Peak Demand Savings (kWh):	2
Estimated Annual kWh Savings ($):	$149	Estimated Annual Demand Savings ($):	$0

Estimated Annual Total Savings ($):	$149	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.1%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. FH-AH1 through FH-AH3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram set point schedule for (3) AHU's. 2) Add master night setback T-stat for each AHU (3) 3) Program setpoints with setbacks for each unit.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	26,497	Contractor Cost ($):	$2,058
Estimated Annual kWh Savings ($):	$931	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$2,522

Estimated Annual Total Savings ($):	$931	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.71	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.71	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	23	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	0.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. FH-AH1 through FH-AH3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU1 remains open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram outdoor air damper open/close schedule for FH-AH1. 2) Reprogram schedule for FH-AH2, 3) Reprogram schedule for FH-AH3.		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	140,451	Contractor Cost ($):	$750
Estimated Annual kWh Savings ($):	$4,937	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$982

Estimated Annual Total Savings ($):	$4,937	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.20	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.20	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	120	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.0%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Supply Air Fans do not have VFDs.	Date Identified:	9/10/2010
Description of Finding:	VAV system fans operate at constant speed even though system has VAV boxes. Pneumatic VAVs are bypass type. (VAV box info not on EMCS).		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Fans		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Photos of bypass boxes. Electric baseboard heat is manually controlled. VAV boxes are pneumatic and are not interlocked with electric baseboard.		
Measure:	Add VFDs to (3) AHU supply fans.		
Recommendation for Implementation:	1) Add VFDs to supply fan motors of 10, 10, and 15 hp. 2) Program VFD operation using Return air temperature in summer and by using 70% flow in winter. Summer - Increase SF speed if RA temperature rises above 78F, decrease speed if RA temperature drops below 75F. (Bypass style boxes will cool the return air plenum if in bypass mode.) Calculate current outside air requirements per ASHRAE and re-balance minimum outside air dampers to provide code required fresh air in the winter (70% fan speed).		
Evidence of Implementation Method:	Trend VFD Speed and Return air temperature over time in summer and winter.		

Annual Electric Savings (kWh):	32,362	Contractor Cost ($):	$12,840
Estimated Annual kWh Savings ($):	$1,138	PBEEEP Provider Cost for Implementation Assistance ($):	$928
		Total Estimated Implementation Cost ($):	$13,768

Estimated Annual Total Savings ($):	$1,138	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	12.10	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	12.10	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	28	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.7%	Percent of Implementation Costs:	1.6%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Founders Hall

FWB Number:	10106	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Replace HID lights with LEDs	Date Identified:	9/10/2010
Description of Finding:	14 HID fixtures was replaced with LED lighting in the Summer of 2011.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install LED Lights		
Recommendation for Implementation:	Replace all HID HPS Lights throughout the building with LED Lights. Already done this last summer.		
Evidence of Implementation Method:	Done.		

Annual Electric Savings (kWh):	4,233	Peak Demand Savings (kWh):	2
Estimated Annual kWh Savings ($):	$149	Estimated Annual Demand Savings ($):	$0

Estimated Annual Total Savings ($):	$149	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.1%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10106 - SMSU - Founders Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X			Verify scheduling, screenshots
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used.
	a.3 (3)	Lighting is on more hours than necessary.	X	Throughout Building		Lights on in unoccupied areas, no occupancy sensors installed.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	HVAC Equipment		Verify economizer operation. Trend and physically check
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	AH1, AH2, AH3		Check OA damper position day and night, Set up trend.
	b.3 (7)	OTHER_Economizer/OA Loads	X	AH1, AH2, AH3		Ensure OA dampers close at night. Trend - Physically check
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X	VAV boxes, Baseboard Heat		Is perimeter electric heat interlocked with "Control Terminals"? What controls Unit di
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	X	AH1, AH2, AH3		No VFDs
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	X	AH1, AH2, AH3		Examine operation of "control terminals". What are minimum set points? Does fan s
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans	X	AH1, AH2, AH3		Potentially add VFDs to fans

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10106 - SMSU - Founders Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers	X	AH1, AH2, AH3		Add to chilled water loop? Add chilled water coils?
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	Equipment is relatively new.
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

ischarge air temperature?

simply ride curve?

Findings Summary

Building: HA - Dorm
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Magnetic Ballasts with T12 Lamps.	$403	$22	17.99	$0	17.99	1
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$403**	**$22**	**17.99**	**$0**	**17.99**	**1**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: HA - Dorm

FWB Number:	10107	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 2LT12 4' with 2LT8 25W NBF (5)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	637	Contractor Cost ($):	$287
Estimated Annual kWh Savings ($):	$22	PBEEEP Provider Cost for Implementation Assistance ($):	$116
		Total Estimated Implementation Cost ($):	$403

Estimated Annual Total Savings ($):	$22	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	17.99	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	17.99	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10107 - SMSU - HA Complex

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Not cost-effective to investigate	Requires 24/7 operation for heating. Does fan cycle off? At night?
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Not Relevant	
	a.3 (3)	Lighting is on more hours than necessary.	X	Dorm Rooms, Common Areas		Lights on during unoccupied times, no occupancy sensors installed.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Not Relevant	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Not Relevant	
	b.3 (7)	OTHER_Economizer/OA Loads	X		Investigation looked for, but did not find this issue.	Review OA damper operation, what is optimal? Is OA damper manually changed from summer to winter?
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Not Relevant	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Not Relevant	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Dorm Rooms, Common Areas		Lights on during unoccupied times, no occupancy sensors installed.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Not Relevant	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Not Relevant	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not cost-effective to investigate	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not cost-effective to investigate	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans			Not cost-effective to investigate	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10107 - SMSU - HA Complex

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not cost-effective to investigate	
	g.3 (30)	VFD Retrofit - Motors (process)			Not cost-effective to investigate	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Lounge, Common Areas		T12 lamps with magnetic ballests were observed. Incandescent lamps
	h.12 (43)	Retrofit - Building Envelope	X		Not cost-effective to investigate	Single pane windows with storms/screens. Observe how many windows open.
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Findings Summary

Building: Maintenance Building
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
5	Magnetic Ballasts with T12 Lamps.	$8,561	$440	19.48	$0	19.48	11
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$8,561**	**$440**	**19.48**	**$0**	**19.48**	**11**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Maintenance Building

FWB Number:	10108	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 2LT12 8' with 4LT8 25W HBF 8' (36) 1LT12 4' with 1LT8 25W NBF (3) 2LT12 4' with 2LT8 25W NBF (43) 3LT12 4' with 2LT8 25W NBF (9)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	12,558	Peak Demand Savings (kWh):	5
Estimated Annual kWh Savings ($):	$440	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$7,169		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,392		
Total Estimated Implementation Cost ($):	$8,561		

Estimated Annual Total Savings ($):	$440	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	19.48	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	19.48	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	11	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.3%	Percent of Implementation Costs:	1.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10108 - SMSU - Maintenance Building

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.	X	Corridors, Offices		Lights on during unoccupied times, no occupancy sensors.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Not Relevant	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Not Relevant	
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Corridors, Offices		Lights on during unoccupied times, no occupancy sensors.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	X	Cooling Tower		Trend VFD on cooling tower fan(s)
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	X	Cooling Tower		Trend VFD on secondary pump
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	X	Condenser		Trend Condenser water temperature
	e.6 (22)	Other_Controls (Reset Schedules)	X	Condenser		Trend CHWR and CHWS temp
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled	X	Cooling Tower		Verify condenser water pumps not throttled. Only 1650 gpm but sized for 2250 gpm.
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans			Not Relevant	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10108 - SMSU - Maintenance Building

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	X	Chillers		Chillers have constant speed motors.
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Findings Summary

Building: Physical Education
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over Ventilation.	$1,982	$13,235	0.15	$0	0.15	324
6	Over Ventilation.	$2,280	$6,033	0.38	$0	0.38	148
5	Heat Wheel No Longer Operational	$32,040	$11,662	2.75	$0	2.75	286
3	Discharge air temperature reset from both Hot deck and cold deck is suboptimal.	$3,012	$754	3.99	$0	3.99	18
1	No night setback.	$5,788	$1,361	4.25	$0	4.25	33
7	Magnetic Ballasts with T12 Lamps.	$17,121	$1,627	10.52	$0	10.52	40
	Total for Findings with Payback 3 years or less:	**$36,302**	**$30,930**	**1.17**	**$0**	**1.17**	**757**
	Total for all Findings:	**$62,223**	**$34,673**	**1.79**	**$0**	**1.79**	**849**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Physical Education

FWB Number:	10109	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. PE-AH1 through PE-AH9.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram room temperature set point schedule for (9) AHU's and (7) zones for Multizone AHU.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	38,884	Contractor Cost ($):	$5,324
Estimated Annual kWh Savings ($):	$1,361	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$5,788

Estimated Annual Total Savings ($):	$1,361	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.25	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.25	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	33	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.8%	Percent of Implementation Costs:	0.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Physical Education

FWB Number:	10109	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. PE-AH1,2,3,5,6,7,9.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU1 remains open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram outdoor damper open/close schedule for PE-AH1, PE-AH2, PE-AH3, PE-AH5, PE-AH6, PE-AH7, PE-AH-9. 2) Test and verify OA damper operation.		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	378,155	Contractor Cost ($):	$1,750
Estimated Annual kWh Savings ($):	$13,235	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$1,982

Estimated Annual Total Savings ($):	$13,235	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.15	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.15	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	324	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	8.1%	Percent of Implementation Costs:	0.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Physical Education

FWB Number:	10109	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Discharge air temperature reset from both Hot deck and cold deck is suboptimal.	Date Identified:	9/10/2010
Description of Finding:	Hot deck and cold deck temps are as much as 45F apart. PE-AH1. In some cases the cold deck temperature is in the high 30's.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of Hot and Cold Deck vs. Time, visual thermometer readings, and manual temperature measurements.		
Measure:	Limit difference between hot deck and cold deck to 25F.		
Recommendation for Implementation:	Program minimum and maximum cold deck and hot deck temperatures. 1) Maintain existing HD CD temperature set point programming except add limits. 2) Add programming and min and max setpoints to existing EMCS system per the following: a) If OAT is less than 0ËšF provide maximum HD temp of 90ËšF and minimum CD temp of 65Ëš. b) If the OAT is between 0ËšF and 55ËšF provide maximum HD temp of 85ËšF and minimum CD temp of 60Ëš. c) If the OAT is between 55ËšF and 75ËšF provide maximum HD temp of 80ËšF and minimum CD temp of 55Ëš. d) If OAT is greater than 75ËšF provide maximum HD temp of 75ËšF and minimum CD temp of 50Ëš.		
Evidence of Implementation Method:	Trends of Hot and Cold Deck vs. Time, visual thermometer readings, and manual temperature measurements. Ensure the temperature difference between HD and CD is not above 25F.		

Annual Electric Savings (kWh):	21,554	Contractor Cost ($):	$2,548
Estimated Annual kWh Savings ($):	$754	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$3,012

Estimated Annual Total Savings ($):	$754	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.99	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.99	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	18	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.5%	Percent of Implementation Costs:	0.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Physical Education

FWB Number:	10109	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Heat Wheel No Longer Operational	Date Identified:	9/10/2010
Description of Finding:	Heat wheel is approximately 40 years old. Effectiveness is 0 as there is no media in the wheel. PE-AH4.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Retrofits
Finding Type:	Retrofit - Energy/Heat Recovery		

Implementer:	Mechanical contractor	Benefits:	Energy savings
Baseline Documentation Method:	Visual inspection of heat wheel, see picture in trend data file.		
Measure:	Replace existing heat wheel with more effective model.		
Recommendation for Implementation:	Program wheel to operate anytime the temperature is below 65F or above 80F. 1) Demo existing heat wheel. 2) Provide new 15,000 cfm heat wheel with at least 65% effectiveness. 3) Provide electrical power to wheel. 4) Commission heat wheel.		
Evidence of Implementation Method:	Visual inspection of heat wheel, add trend point to heat wheel to ensure it is running at the appropriate time. Trend all temperatures and fan statuses in the HRW and AHU over at least two weeks that have significant amounts of time with the AHU operating at temperatures above 80F, below 65F, and inbetween these two temperatures. Analyze trend data to verify activitation and deactivation of heat recovery at appropriate times, and to verify heat recovery effectiveness when active.		

Annual Electric Savings (kWh):	333,198	Contractor Cost ($):	$29,720
Estimated Annual kWh Savings ($):	$11,662	PBEEEP Provider Cost for Implementation Assistance ($):	$2,320
		Total Estimated Implementation Cost ($):	$32,040

Estimated Annual Total Savings ($):	$11,662	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.75	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.75	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	286	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	7.2%	Percent of Implementation Costs:	3.8%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Physical Education

FWB Number:	10109	Eco Number:	6
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Turn off 100% OA units at night (PE-AH4 and PE-AH8).		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of the SF Command and OA Damper position show they do not turn off at night.		
Measure:	Schedule heat wheel and PE-AH8 to shut down at night.		
Recommendation for Implementation:	Schedule each unit to shut down between 11pm and 6am. 1) Reprogram schedule for PE-AH4. 2) Reprogram schedule for PE-AH8. 3) Ensure that each units outside air damper closes, electric heat shuts off, heat recovery shuts off, and supply and exhaust fans turn off.		
Evidence of Implementation Method:	Trend the SF Command and OA Damper position show they are working properly and shutting down during the night/unoccupied hours.		

Annual Electric Savings (kWh):	172,372	Contractor Cost ($):	$2,048
Estimated Annual kWh Savings ($):	$6,033	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$2,280

Estimated Annual Total Savings ($):	$6,033	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.38	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.38	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	148	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.7%	Percent of Implementation Costs:	0.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Physical Education

FWB Number:	10109	Eco Number:	7
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 2LT12 8' with 4LT8 25W HBF 8' (48) 3LT12 8' with 4LT8 25W HBF 8' (48) 1LT12 4' with 1LT8 25W NBF (117) 2LT12 4' with 2LT8 25W NBF (149)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	46,486	Peak Demand Savings (kWh):	18
Estimated Annual kWh Savings ($):	$1,627	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$15,265		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,856		
Total Estimated Implementation Cost ($):	$17,121		

Estimated Annual Total Savings ($):	$1,627	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	10.52	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	10.52	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	40	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.0%	Percent of Implementation Costs:	2.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10109 - SMSU - Physical Education

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	All AHU		Verify scheduling, screenshot (All units).
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used.
	a.3 (3)	Lighting is on more hours than necessary.	X	Throughout Building		Lights on during unoccupied times, no occupancy sensors installed.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AH1, AH7, AH9		Trend Economizer (OA and RA dampers) on AH1,7,9.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	AH1, AH2, AH4, AH7, AH9		Trend OA dampers on units 1, 2, 4, 7, and 9.
	b.3 (7)	OTHER_Economizer/OA Loads	X	OA Dampers, Economizers		Do OA air dampers close at night? Are economizers working?
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X	AH1		AH1 multi-zone, trend cold deck and hot deck temps.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Throughout Building		Lights on during unoccupied times, no occupancy sensors installed.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	X	AH8		Verify run-around-loop operational on AH8.
	g.1 (28)	VFD Retrofit - Fans			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10109 - SMSU - Physical Education

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	
	g.3 (30)	VFD Retrofit - Motors (process)			Investigation looked for, but did not find this issue.	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery	X	AH4		Re-commission heat wheel on AH4.
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Findings Summary

Building: Recreation Athletics Facilities

Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over Ventilation.	$2,714	$10,378	0.26	$0	0.26	253
5	Over Ventilation.	$2,000	$4,606	0.43	$0	0.43	112
1	No night setback.	$1,384	$3,117	0.44	$0	0.44	76
	Total for Findings with Payback 3 years or less:	**$6,098**	**$18,100**	**0.34**	**$0**	**0.34**	**441**
	Total for all Findings:	**$6,098**	**$18,100**	**0.34**	**$0**	**0.34**	**441**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Recreation Athletics Facilities

FWB Number:	10110	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. RA-AHU1 through RA-AHU9.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends, discussions with personnel and visual inspection		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram temperature set point schedule for (9) AHU's.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	88,676	Contractor Cost ($):	$1,152
Estimated Annual kWh Savings ($):	$3,117	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$1,384

Estimated Annual Total Savings ($):	$3,117	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.44	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.44	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	76	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.9%	Percent of Implementation Costs:	0.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Recreation Athletics Facilities

FWB Number:	10110	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. RA-AHU1-9.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHUs remain open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram outdoor air damper open/close schedule for (9) AHU's.		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	295,241	Contractor Cost ($):	$2,250
Estimated Annual kWh Savings ($):	$10,378	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$2,714

Estimated Annual Total Savings ($):	$10,378	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.26	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.26	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	253	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	6.4%	Percent of Implementation Costs:	0.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Recreation Athletics Facilities

FWB Number:	10110	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Turn off 100% OA unit at night (RA-MAH-1).		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of SF over time shows it never turns off, even at night and visual inspection.		
Measure:	Schedule RA-MAH-1 to shut down at night.		
Recommendation for Implementation:	Schedule Air Handling Unit to shut down between 11pm and 6am. 1) Reprogram schedule for RA-MAH1. 2) Ensure that the unit's outside air damper closes, electric heat shuts off, heat recovery shuts off, and supply and exhaust fans turn off.		
Evidence of Implementation Method:	Trend the SF Command and OA Damper position show they are working properly and shutting down during the night/unoccupied hours.		

Annual Electric Savings (kWh):	131,027	Contractor Cost ($):	$1,536
Estimated Annual kWh Savings ($):	$4,606	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$2,000

Estimated Annual Total Savings ($):	$4,606	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.43	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.43	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	112	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.8%	Percent of Implementation Costs:	0.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10110 - SMSU - Recreation Athletic Facility

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	MAU1		Verify Scheduling of all AHU's, especially MAU-1, Screenshots
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used
	a.3 (3)	Lighting is on more hours than necessary.			Not cost-effective to investigate	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AH1-9		Trend economizer on AHU-6, 9 which have chilled water coils. Do economizers work on AHUs 1-5, 7&8 (No cooling coils)? Screenshots show Econ Setpt.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	AH1		Trend OA damper or "mixed air" damper for all AHUs. Do they close at night? Is return air quality set point too conservative at 800 ppm CO2? Does MAU-1 shut down at night - fan and OA damper?
	b.3 (7)	OTHER_Economizer/OA Loads	X	AH1		heat coils? Trend heating coil command. Trend all VAV boxes which deliver OA to AHU's. What controls VAV box?
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls	X	AH1		Trend discharge air temp of AHU-1 field house unit. Does it get too hot? Air is disch
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not cost-effective to investigate	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Not cost-effective to investigate	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Not cost-effective to investigate	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not cost-effective to investigate	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not cost-effective to investigate	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	X	AH1, MAU1		Trend heat recovery operation, OA and RA temps (AHU-1 and MAU-1)
	g.1 (28)	VFD Retrofit - Fans			Not cost-effective to investigate	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10110 - SMSU - Recreation Athletic Facility

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not cost-effective to investigate	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Weight Room, Cardio Room		Update lighting in the weight room and cardio room.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

ıarged high above floor.

Findings Summary

Building: Science and Technology
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over Ventilation.	$2,672	$2,169	1.23	$0	1.23	53
1	No night setback.	$732	$529	1.38	$0	1.38	13
3	Magnetic Ballasts with T12 Lamps.	$20,071	$2,021	9.93	$0	9.93	49
	Total for Findings with Payback 3 years or less:	**$3,404**	**$2,697**	**1.26**	**$0**	**1.26**	**66**
	Total for all Findings:	**$23,475**	**$4,718**	**4.98**	**$0**	**4.98**	**116**

Findings Details

PBEEEP State Government

Building: Science and Technology

FWB Number:	10111	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. ST-AH2.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of room temperatures over time shows that it does not drop at night, discussions with personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram temperature set point schedule for ST-AH2. 2) Provide DDC night setback sensors for ST-AH2 in (4) critical locations 3) Program setpoints with setbacks.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	15,105	Contractor Cost ($):	$500
Estimated Annual kWh Savings ($):	$529	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$732

Estimated Annual Total Savings ($):	$529	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.38	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.38	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	13	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.3%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Science and Technology

FWB Number:	10111	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. ST-AH2.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU2 remains open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am. 1) Reprogram damper open/close schedule for ST-AH2. 2) Re-commission damper/verify operation per new schedule.		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	61,964	Contractor Cost ($):	$2,208
Estimated Annual kWh Savings ($):	$2,169	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$2,672

Estimated Annual Total Savings ($):	$2,169	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.23	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.23	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	53	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.3%	Percent of Implementation Costs:	0.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Science and Technology

FWB Number:	10111	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 2LT12 4' with 2LT8 25W NBF (18) 3LT12 4' with 2LT8 25W NBF (59) 4LT12 4' with 4LT8 25W NBF (186)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	57,742	Peak Demand Savings (kWh):	18
Estimated Annual kWh Savings ($):	$2,021	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$18,215		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,856		
Total Estimated Implementation Cost ($):	$20,071		

Estimated Annual Total Savings ($):	$2,021	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	9.93	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	9.93	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	49	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.2%	Percent of Implementation Costs:	2.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10111 - SMSU - Science & Technology

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AH2		Verify scheduling of units. Screenshots. Include lab hood exhaust fans.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used
	a.3 (3)	Lighting is on more hours than necessary.	X	Corridors, Classrooms		Lights were left on, no occupancy sensors were installed in corridors and classroom
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	AH2		Verify OA damper positions. Trend. How is OA damper controlled vs Lab hood use?
	b.3 (7)	OTHER_Economizer/OA Loads	X			Verify Economizer use. Trend
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X			Trend Dual Duct unit hot and cold deck temps.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Corridors, Classrooms		Lights were left on, no occupancy sensors were installed in corridors and classroom
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	X	Science Labs		Can Lab hood fans be slowed down at night and have bypass damper close? Or is high plume needed?
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)	X			Heat Recovery commissioned yet?
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10111 - SMSU - Science & Technology

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER	X			Current project in progress

s.

s.

Findings Summary

Building: Social Science
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over Ventilation.	$982	$2,925	0.34	$0	0.34	71
1	No night setback.	$2,024	$2,004	1.01	$0	1.01	49
3	No VAV boxes or VFDs on supply fans. Electric Zone Reheat Coils.	$21,368	$2,909	7.35	$0	7.35	71
5	Magnetic Ballasts with T12 Lamps.	$11,917	$951	12.53	$0	12.53	23
	Total for Findings with Payback 3 years or less:	**$3,006**	**$4,929**	**0.61**	**$0**	**0.61**	**120**
	Total for all Findings:	**$36,291**	**$8,789**	**4.13**	**$0**	**4.13**	**214**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Social Science

FWB Number:	10112	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No night setback.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. SS-AH1 through SS-AH3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with personnel who said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm. Stage units back on one half hour apart each. 1) Reprogram temperature set point schedule for SS-AH1, SS-AH2, and SS-AH3. 2) Reset zone temperature set points for each zone. (Approximately 100). Zone temperatures are on EMCS system.		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	57,009	Contractor Cost ($):	$1,792
Estimated Annual kWh Savings ($):	$2,004	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$2,024

Estimated Annual Total Savings ($):	$2,004	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.01	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.01	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	49	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.2%	Percent of Implementation Costs:	0.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Social Science

FWB Number:	10112	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. SS-AH1,2,3.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows they remain open at night and visual inspection.		
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Recommendation for Implementation:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.		
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.		

Annual Electric Savings (kWh):	83,217	Contractor Cost ($):	$750
Estimated Annual kWh Savings ($):	$2,925	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$982

Estimated Annual Total Savings ($):	$2,925	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.34	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.34	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	71	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.8%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Social Science

FWB Number:	10112	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No VAV boxes or VFDs on supply fans. Electric Zone Reheat Coils.	Date Identified:	9/10/2010
Description of Finding:	Zone control has electric reheat coils only - no VAV boxes.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	VAV Box Minimum Flow Setpoint is higher than necessary		

Implementer:	Controls Contractor	Benefits:	Energy savings on fan motors and heating coils
Baseline Documentation Method:	Visual inspected the building, existing drawings show no VAV boxes.		
Measure:	Add VFD's on each supply fan motor in AHU's 1,2,3. Control supply fan speed in summer using sample of ciritcal zone temps. Drop Supply fan speed in winter to 50-70%.		
Recommendation for Implementation:	Install VFD's on the fans for AHU1,2,3 so they can control the fan output based on the required load. 1) Provide controls to set discharge air temperature to constant 55F set point during cooling season and 60F during heating season (adjustable). 2) Provide discharge air temperature during winter as high as possible by sampling zones, if any are too warm then adjust AHU DAT down and vice versa. 3) Provide VFD on (3) supply fans AHU's 1,2,3. (40hp + 15 hp + 7.5 hp) 4) Provide controls to vary the fan speed for each AHU based on zone temperature(s) during cooling season. If all zones are satisfied then slow the fan speed. 5) Provide controls to set heating season supply fan speed at 70% (adjustable). Note: AHU and Zone Electric Heating coils will need to see a minimum air flow in order to operate properly, dropping AHU fan speed below 70% may cause coils to lose power.		
Evidence of Implementation Method:	Visually verify VFD installation. Trend the VFD speed and RAT over time to ensure they are working correctly per the recommendations.		

Annual Electric Savings (kWh):	82,761	Contractor Cost ($):	$19,512
Estimated Annual kWh Savings ($):	$2,909	PBEEEP Provider Cost for Implementation Assistance ($):	$1,856
		Total Estimated Implementation Cost ($):	$21,368

Estimated Annual Total Savings ($):	$2,909	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	7.35	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	7.35	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	71	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.8%	Percent of Implementation Costs:	2.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Social Science

FWB Number:	10112	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Magnetic Ballasts with T12 Lamps.	Date Identified:	9/10/2010
Description of Finding:	Magnetic ballasts with T12 lamps were found throughout the building. CEE Calculation and Recommended Implementation.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Lighting contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Visually inspection of light fixtures concluded that T12 lamps with magnetic ballasts were installed throughout the building.		
Measure:	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.		
Recommendation for Implementation:	Replace bulbs and ballasts in described lighting fixtures. 1LT12 4' with 1LT8 25W NBF (0) 2LT12 4' with 2LT8 25W NBF (0) 3LT12 4' with 2LT8 25W NBF (62) 4LT12 4' with 4LT8 25W NBF (99)		
Evidence of Implementation Method:	Visually inspect the building and look in the maintenance rooms to ensure T8 lamps with electronic ballasts are being installed.		

Annual Electric Savings (kWh):	27,065	Peak Demand Savings (kWh):	12
Estimated Annual kWh Savings ($):	$951	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$10,989		
PBEEEP Provider Cost for Implementation Assistance ($):	$928		
Total Estimated Implementation Cost ($):	$11,917		

Estimated Annual Total Savings ($):	$951	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	12.53	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	12.53	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	23	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	1.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10112 - SMSU - Social Science

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AH1, AH2, Ah3		Verify AHU scheduling, screenshots
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used
	a.3 (3)	Lighting is on more hours than necessary.	X	Classrooms, Offices		Lights were left on, no occupancy sensors were installed in the classrooms and office
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	Economizers		Trend economizer command
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads	X	AH1, AH2, Ah3		Trend OA damper position - all AHUs
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	X			Trend Electric heat coil and Cooling coil valves
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls	X	AH1, AH3		Trend heat wheel operation
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Classrooms, Offices		Lights were left on, no occupancy sensors were installed in the classrooms and office
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans	X	VAV Boxes		Add VAV boxes

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10112 - SMSU - Social Science

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

ɛs.

ɛs.

Findings Summary

Building: Student Center
Site: Southwest MSU

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Over Ventilation.	$732	$6,487	0.11	$0	0.11	158
6	Over Ventilation.	$3,024	$1,838	1.65	$0	1.65	45
2	Night Setback not used.	$4,776	$2,406	1.98	$0	1.98	59
8	Over Ventilation.	$0	$0	3.49	$0	3.49	0
3	AHU Supply Air and return air fans speeds do not vary sufficiently.	$10,356	$2,502	4.14	$0	4.14	61
5	No VFD on Heating water pumps.	$5,826	$439	13.28	$0	13.28	11
	Total for Findings with Payback 3 years or less:	**$8,532**	**$10,731**	**0.80**	**$0**	**0.80**	**262**
	Total for all Findings:	**$24,714**	**$13,672**	**1.81**	**$0**	**1.81**	**333**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Student Center

FWB Number:	10113	Eco Number:	1
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	Minimum OA dampers remain open at night. SC-AHU-1.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor
Benefits:	Energy savings
Baseline Documentation Method:	Trends of OA Damper position over time shows AHU1 remains open at night and visual inspection.
Measure:	Program/Schedule OA dampers to close between the hours of 11pm and 6am.
Recommendation for Implementation:	Program/Schedule OA dampers on SC-AHU-1 to close between the hours of 11pm and 6am.
Evidence of Implementation Method:	Trend OA Damper position over time and visual inspection to ensure the dampers close at night.

Annual Electric Savings (kWh):	184,549	Contractor Cost ($):	$500
Estimated Annual kWh Savings ($):	$6,487	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$732

Estimated Annual Total Savings ($):	$6,487	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.11	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.11	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	158	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.0%	Percent of Implementation Costs:	0.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Student Center

FWB Number:	10113	Eco Number:	2
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Night Setback not used.	Date Identified:	9/10/2010
Description of Finding:	Units and zones do not set back at night to avoid high morning peaks which may result in overrunning their electricity allotment. SC-AHU-1, SC-AHU-2.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of the RA temp shows that it does not drop at night, discussions with building personnel said they do not use any NSB and visual inspection.		
Measure:	Employ night setback 5F at night. Stage units on at various times to avoid demand spike.		
Recommendation for Implementation:	Setback zone temperatures 5F at 11pm until 5 am (adjustable).		
Evidence of Implementation Method:	Trend multiple zone temperatures and make sure they drop at night, discussions with personnel to ensure they started using a NSB cycle and visual inspection.		

Annual Electric Savings (kWh):	68,454	Contractor Cost ($):	$4,544
Estimated Annual kWh Savings ($):	$2,406	PBEEEP Provider Cost for Implementation Assistance ($):	$232
		Total Estimated Implementation Cost ($):	$4,776

Estimated Annual Total Savings ($):	$2,406	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.98	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.98	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	59	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.5%	Percent of Implementation Costs:	0.6%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Student Center

FWB Number:	10113	Eco Number:	3
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Supply Air and return air fans speeds do not vary sufficiently.	Date Identified:	9/10/2010
Description of Finding:	VAV system fans operate at high speed (close to 60 Hz) even when many VAV boxes are in heating or cooling mode. SC-AHU-1.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Fan Speed Doesn't Vary Sufficiently		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Visual VFD speed, Trend SF and RF speed shows it does not slow down when VAV boxes are in heating mode.		
Measure:	Lower Fan Speed.		
Recommendation for Implementation:	1) Re-calibrate static pressure sensor. 2) Lower SC-AH1 discharge air temperature to 55F in summer, and raise to 60F in winter. 3) Re-calibrate (10) VAV boxes in critical zones. 4) Fix or replace (5) VAV boxes if undersized or causing the fan to operate at higher speed than necessary. 5) Lower static pressure sensor set point. 6) Verify that outdoor air damper is set to minimum position except when in economizer mode [and correct programming and/or equipment as necessary]. 7) Re-calibrate air flow measuring station to ensure proper return air fan performance. 8) Verify that return air fan properly varies speed based upon air flow measuring station differential set point [and correct programming and/or equipment as necessary]. 9) Set winter DAT to no lower than 60F.		
Evidence of Implementation Method:	For each air handler trend the following over at least one week in summer and one week in winter: supply adn return fan speeds, static pressure, static pressure setpoint, return air flow, return air flow setpoint, DAT and DAT sepoint (plus VAV box flow setpoint, flow and damper position where possible). Confirm that the supply fan speed varies between 50-80% speed under most conditions, that the duct static pressure setpoint is met, that return air flow setpoint is met, that OA damper varies appropriately with RF speed, and that the DAT appropriately varies seasonally between 55 and 60Â°F.		

Annual Electric Savings (kWh):	71,171	Contractor Cost ($):	$8,964
Estimated Annual kWh Savings ($):	$2,502	PBEEEP Provider Cost for Implementation Assistance ($):	$1,392
		Total Estimated Implementation Cost ($):	$10,356

Estimated Annual Total Savings ($):	$2,502	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.14	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.14	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	61	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.5%	Percent of Implementation Costs:	1.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Student Center

FWB Number:	10113	Eco Number:	5
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	No VFD on Heating water pumps.	Date Identified:	9/10/2010
Description of Finding:	Main Heating water pumps are 5 hp and do not have VFD.		
Equipment or System(s):	Pump, HW distribution	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Pumps		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Visualy verified there were no VFD's, looked at trends to determine they are constant volume pumps.		
Measure:	Install VFD on 5 hp water pumps.		
Recommendation for Implementation:	Install VFD on the 5 hp water pumps so they do not run at full load 100% of the time.		
Evidence of Implementation Method:	Visualy verify that VFD's are installed, trend VFD command and OA temperature over time to ensure it is properly working.		

Annual Electric Savings (kWh):	12,481	Contractor Cost ($):	$5,362
Estimated Annual kWh Savings ($):	$439	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$5,826

Estimated Annual Total Savings ($):	$439	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	13.28	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	13.28	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	11	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.3%	Percent of Implementation Costs:	0.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Student Center

FWB Number:	10113	Eco Number:	6
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	100% OA unit (AHU-2) runs at night to make up air due to kitchen exhaust fans running at various speeds. Exhaust fans cannot be turned off due to odor problems but could be turned down lower.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trend of OA on AHU2 shows it is running at night. Trends of Exhaust fan show they run on the high command at night.		
Measure:	Reduce speed of kitchen exhaust fans (EF-5, 6, 9). Minimize speed of 100% OA unit at night (Kitchen Make-up air unit) SC-AHU-2.		
Recommendation for Implementation:	1) Reschedule exhaust fans EF-5,6,9 to slow down an additional 10% of flow after Student Center Kitchen Closes. 2) Re-commission SC-AHU-2 supply fan VFD operation speed, ensure speed slows with Efs, and when VAV go to unoccupied mode. 3) Add unoccupied points to VAV boxes serving kitchen area and schedule to swithc to unoccupied per owners timing.		
Evidence of Implementation Method:	Trend the OA and SF speed on AHU2 to show it turns down at night. Trend the Exhaust fan to show they slow down at night.		

Annual Electric Savings (kWh):	52,295	Contractor Cost ($):	$2,560
Estimated Annual kWh Savings ($):	$1,838	PBEEEP Provider Cost for Implementation Assistance ($):	$464
		Total Estimated Implementation Cost ($):	$3,024

Estimated Annual Total Savings ($):	$1,838	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.65	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.65	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	45	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.1%	Percent of Implementation Costs:	0.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Student Center

FWB Number:	10113	Eco Number:	8
Site:	Southwest MSU	Date/Time Created:	1/18/2012

Investigation Finding:	Over Ventilation.	Date Identified:	9/10/2010
Description of Finding:	ALT #6 & #3: 100% OA unit (AHU-2) runs at night to make up air due to kitchen exhaust fans running at various speeds. Exhaust fans cannot be turned off due to odor problems but could be turned down lower. This calculation was done by CEE as an alternate to #6 and #3. The savings and costs are approximate. 98,440kWh Savings ($3150), $7000 Contractor Cost, $5000 Design Cost, 3.5 yr payback		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls Contractor and TAB Contractor.	Benefits:	Energy savings
Baseline Documentation Method:	Trend all points on the system, including a sample of VAV boxes and look for nightly operation of exhaust fans and AHU-1.		
Measure:	replace/recalibrate sensor and enable unoccupied mode.		
Recommendation for Implementation:	Shut off as many Exhaust Fans as possible during unoccupied time to reduce OA intake cfm. Recalibrate/replace the DSP sensor and program an unocc mode for all th eVAV boxes in the spaces to reduce the fan energy use and OA load on the building. The VAV boxes should also be gone over by a TAB contracto to ensure propoer operation of damper and cfm.		
Evidence of Implementation Method:	Trend all points on the system, including a sample of VAV boxes and look for nightly operation of exhaust fans and AHU-1.		

Annual Electric Savings (kWh):	1	Contractor Cost ($):	$0
Estimated Annual kWh Savings ($):	$0	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$0

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.49	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.49	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10113 - SMSU - Student Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	Throughout Building		Verify Scheduling, screenshot.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Throughout Building		Night Setback, unoccupied cycle not used.
	a.3 (3)	Lighting is on more hours than necessary.	X	Throughout Building		Have dedicated computer for this, but curently not utilizing its capabilities.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	CHWP and HWP run only as needed.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	HVAC Economizer		Review economizer set point and mixed air low limit, verify economizer operation.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	HVAC Equipment		Check OA damper position day and night, Set up trend.
	b.3 (7)	OTHER_Economizer/OA Loads	X	HVAC Equipment		Trend OA temperature.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	X	Throughout Building		Have a dedicated computer to control lighting but currently not using this.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	X	Throughout Building		Night Setback, unoccupied cycle not used.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	X	AHU1		[illegible] up trends for supply fan speed, and static pressure. Look at static pr sensor. Dampers closed?
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	X	AHU1, AHU2		VAV system fans operate at high speed (close to 60 Hz) even when many VAV boxe
	d.6 (17)	Other_Controls (Setpoint Changes)	X			Check ductwork near these boxes, dampers etc.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	X			Check /Trend Boiler modulation and screenshoot reset schedule.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not Relevant	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not cost-effective to investigate	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans			Not cost-effective to investigate	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

P10113 - SMSU - Student Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	X	Main Heating Water Pumps		Heating water pumps are 5 hp, use VFD.
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				Need to check this.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	Equipment is relatively new.
	h.4 (35)	Retrofit - Boilers			Not cost-effective to investigate	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Not cost-effective to investigate	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting	X	Throughout Building		Many T12 lamps with Magnetic ballasts are used.
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Not cost-effective to investigate	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not cost-effective to investigate	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

s are in heating mode.

Southwest Minnesota State University
PBEEEP Program, Investigation Phase

AMEC Comments

Results and Recommendations In Addition to the Findings Workbooks

In order to use Night Setback without exceeding SMSU's electrical demand allotment the following should be considered.

1) Start using night setback on a small scale. Schedule only two or three buildings with setbacks and note the results on the kW meter in the Maintenance Office especially on cold days.
2) Schedule the Night Setback to start at the earliest hour that is practical for each building. Stage the Morning Warm-up cycle to start at a different time for each building or system. Start the Morning Warm-up cycle for 2-3 buildings a half an hour apart. Some buildings may need to be started as early as 4:00 am, some at 4:30 am etc.
3) If the electricity allotment is approached only on extremely cold nights then program the system such that if the outside air temperature gets extremely cold, do not use night setback. As an example starting point – during the winter allotment of 10,000 kW the night setback may be locked out if the outdoor air temperature gets below -5˚F. The lockout temperature set points should be adjustable.
4) Keep in mind that the Morning Warm-up cycle happens while the building is still unoccupied, so no fresh air should be brought in during this cycle.
5) If a large area or an entire building takes too long warming up after a night setback, try raising the heating water temperature (if hot water coils are used) during the warm-up cycle. Schedule these buildings to start morning warm-up earlier than the others.

Founders Hall

1) Founders Hall is served by three constant volume Air Handling Units with Direct Expansion Refrigerant Coils. The building is zoned with pneumatic bypass style VAV boxes. The AHU's and the VAV boxes do not have heating coils. The heat for Founders Hall is entirely generated by the electric baseboard radiation. This baseboard does not have automatic controls – it simply has a manual dial to turn the system up or down. This can result in the VAV boxes and the manual baseboard heat fighting each other.

Future Considerations to Avoid Electricity Allotment Overruns

1) Convert domestic water heaters and heating water boilers to high efficiency natural gas (condensing type). There are a limited number of locations for this equipment and each has a considerable capacity. These units are all located in mechanical rooms. Combustion air, natural gas source and piping, and a clear path for a discharge flue will be required.

Deleted Findings for Southwest Minnesota State University

FWB Number	Description of Finding	Measure	Total Estimated Implementation Cost ($)	Initial Simple Payback (years)
Rec Ath Facility	Supply fan and return fan motors for AHU-1 were found to be standard efficiency. Supply fan for MAH-1 was also a standard efficient model.	Install High Efficient Motors.	$ 15,732	22.8
Bellows	Supply fan motors for AHU-2,3,4 were observed to be standard efficiency.	Install High Efficient Motors.	$ 9,364	23.3
Fine Arts	Hot deck and cold deck temps are often as much as 25-30F apart. FA-AH5 and FA-AH7. Continue to gather trend data this winter.	Limit difference between hot deck and cold deck to 25F.	$ 3,536	155.1
Conference Center	Economizer was not working when it should have been. Conflicting set points. The Mixed Air Low Limit was set to 60F while the Economizer Setpoint was set at 62F. During visit Economizer was not working at 57F OAT. (AHU-1,2,3,4.)	Program/Fix Economizers.	$ 2,268	22.0
Fine Arts	Heat wheel is approximately 40 years old. Effectiveness was found through temperature measurements on all sides of heat wheel.	Replace existing heat wheel with more effective model.	$ 16,432	57.6
Fine Arts	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.	$ 6,005	26.7
Commons East	Magnetic ballasts with T12 lamps were found throughout the building. CEE calculation and recommended implementation.	Install Electronic Ballasts with low watt (28 watt) T8 Lamps.	$ 2,076	31.0
Social Science	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 10,739	20.1
Physical Education	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 7,800	20.2
Bellows	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 34,564	23.7
Charter Hall	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 25,402	36.2
Founders Hall	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 10,907	47.2
Fine Arts	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 1,785	62.3
Commons East	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 3,107	80.5
HA Dorm	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.	$ 3,636	89.1
Science and Technology	No lighting controls were found and lights were on in several areas when they were unoccupied.	Install Occupancy Sensors.		

Founders Hall	Existing FH-AH1 through FH-AH3 units have DX cooling coils. Replace with chilled water coils and provide chilled water to coils.	Provide chilled water from central system to replace condensing units.	$ 101,384	58.2
Bellows	Heat wheels are approximately 40 years old. Effectiveness was measured and this Finding was determined Not Feasible. BAH1, AHU-6.	Replace existing heat wheel with more effective model.	$ 18,904	2076.7
Founders Hall	14 HID fixtures was replaced with LED lighting in the Summer of 2011.	Install LED Lights		
Bellows	Return fans are actually exhaust fans and should run at high speed during economizer and low during normal operation. AHU-4 Exhaust Fan operates based upon building pressure.	Re-commission Exhaust fans to operate per original sequence of operation. Fans should vary speed based upon economizer operation and other exhaust fan speeds or building pressure. They should not track supply fan speed.	$ 2,000	

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR MnSCU - SMSU

Minnesota STATE COLLEGES & UNIVERSITIES

SOUTHWEST MINNESOTA STATE UNIVERSITY

05/20/10

Summary Table

Facility Name	Southwest Minnesota State University
Location	1501 State Street, Marshall, MN
Facility Manager	Cynthia Holm
Number of Buildings	26
Interior Square Footage	1,229,932
PBEEEP Provider	Center for Energy and Environment
Date Visited	3/29/10-4/2/10
Site Project Manager	Cynthia Holm
Annual Energy Cost	$1,078,429 (2009)
Utility Company	Western Area Power Association for Electric Great Plains Natural Gas Company for Natural Gas
Site Energy Use Index (EUI)	95.0 kBtu/sq. ft (2009)
Benchmark EUI (from B3)	143.0 kBtu/sq. ft

Recommendation:

A detailed investigation of the energy usage and energy savings opportunities of the thirteen buildings listed below totaling 787,839 interior square feet at SMSU is recommended at this time.

Building Name	State ID	Area (Square Feet)	Year Built
Bellows Academic Center	E26075S0167/1405	177,780	1967/69/05
Charter Hall	E26075S0670	55,618	1970
Commons East	E26075S5670	5,363	1970
Conference Center	E26075S5970	31,989	1970/96/05
Fine Arts	E26075S0268	57,650	1968
Founders Hall	E26075S1073	33,400	1973
HA Complex	E26075S5770	43,167	1970
Maintenance Building	E260750570	12,500	1970/07
Physical Education	E26075S0368	98,764	1968/70
Recreation Athletic Facility	E26075S1295	71,033	1995
Science & Technology	E26075S0470	70,285	1970
Social Science	E26075S1173	53,350	1973
Student Center	E26075S8073	76,940	1970/2005

SMSU Screening Overview

The goal of screening is to identify buildings where an in-depth energy investigation can be performed to identify energy saving opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. The screening of the site was performed by AMEC Earth and Environmental (AMEC) with the assistance of the facility staff. Four days of walk-throughs were conducted on the week of 3/31/2010 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and its potential for recommissioning. CEE followed up and did a half-day site visit on 5/4/2010. This report is the result of the information gathered by AMEC and CEE.

The site is made up of twenty-six buildings totaling 1,229,932 interior square feet. There is a single automation system (Johnson Controls Metasys) which controls all the air handling and central plant equipment on the campus. The controls are DDC, but the actuation is mostly pneumatic. Some equipment is only monitored from the BAS. The buildings were all constructed between 1967 and 2009. There have been some major mechanical upgrades during the history of the facility but largely the equipment is original to the buildings. All of the campus is heated, but only twelve of the buildings are cooled.

The school operates year round, but with greatly reduced enrollment during the summer. The Western Area Power Association (a federal power agency that distributes hydroelectric power) provides electricity to the campus through one meter and limits the demand the campus can use. During the summer months, the limit is 5MW, and during the winter, it is 10MW. If the campus goes over the limit, they must buy demand and energy from the open market, which is more expensive than WAPA. The campus is almost entirely on electric energy, only Sweetland Hall has natural gas equipment. There are two electric meters and four natural gas meters at SMSU. None of the buildings are sub-metered or metered individually.

Mechanical Equipment Summary Table	
1	Johnson Controls Metasys 4 Automation System
29	Buildings
1,229,932	Square Feet
101	Air Handlers
225	Terminal Units
4	Chillers
2	Cooling Towers
9	Electric Hot Water Boilers
2	Natural Gas Hot Water Boilers

Reasons for Recommendations

The buildings are divided into three categories in this report: those that are recommended for energy investigation; those that were considered, but not recommended; and those that were poor candidates for investigation.

There are many factors that are part of the decision to recommend a building for investigation at SMSU, the following characteristics were important in the building selection process. The buildings recommended for investigation have:

- Large contiguous square footage
- Direct connection to the building automation system
- Mostly electric heating
- Occupancy schedules that vary in the facility

The buildings recommended for investigation are:

- Bellows Hall
- Charter
- Commons East
- Conference Center
- Fine Arts
- Founders Hall
- HA Complex
- Maintenance Building
- Physical Education
- Recreation Athletic Facility
- Science & Technology
- Social Science
- Student Center

The buildings that should be considered by SMSU for investigation are:

- Commons Central
- Commons West
- G Residence
- GM Residence
- GW Residence
- HB Residence
- HC Residence
- Individualized Learning
- Regional Event Center
- Science & Math
- Sweetland Hall

The buildings not recommended for investigation are:

- Child Care Center
- Vehicle Storage Building

Recommended for Investigation:

The thirteen buildings listed below, totaling 787,839 $ft^{2,}$ are good candidates for investigation. Each of these buildings has a large floor area, several air handling units, and is controlled by the building automation system.

Mechanical Equipment Summary Table	
1	Johnson Controls Metasys 4 Automation System
13	Buildings
787,839	Square Feet
62	Air Handlers
132	Terminal Units
4	Chillers
2	Cooling Towers
8	Electric Hot Water Boilers

Bellows Academic Center	State ID# E26075S0167/1405				
Area (sq.ft.)	177,780	Year Built	1967/69/2005	Occupancy (hrs/yr)	5,460*

HVAC Equipment

Name	Type	Size	Notes
BA-AH1	Constant Volume		In Bellows.
BA-AH2	Constant Volume		In Bellows.
BA-AH12	Face and Bypass CV		In Bellows.
BA-AH13	Constant Volume		In Bellows.
AHU-1	FBP Constant Volume		In Library. No Return Fan
AHU-2	VAV		In Library. Has 2 VAVs on BAS
AHU-3	VAV		In Library. Has 30 VAVs on BAS
AHU-4	VAV		In Library. Has 31 VAVs on BAS
AHU-5	Constant Volume		In Library. No Return Fan
AHU-6	Constant Volume		In Library. Heat Recovery Unit
Boiler1 Boiler2	Electric Boiler (2X)	210kW (2X) 20hp pumps (2X)	In Library.
EF5	Exhaust Fan		In Library.

Notes

*Bellows consists of classrooms and a library. The classrooms are open 3,240 hrs per year and the library is open 5,460 hrs/yr.

Bellows (Continued)

Points on BAS

Name	List of Points	Notes
BA-AH12	SF-S, Cooling Valve, Heating Output, DAT and setpoint, MAT, RAT, OAT, Mixed Air damper Position, Room Temperature and setpoint, Face and Bypass damper, Economizer setpoint, Occupancy	
BA-AH13	SF-S, Heating Output, DAT and setpoint, MAT, RAT, OAT, Mixed Air damper Position, Room Temperature and setpoint, Occupancy	
BA-AH1	SF-S, RF-S, EF-S, Heat Recovery Status, Cooling Valve, Heating Output, DAT and setpoint, MAT, RAT, OAT, Mixed Air damper Position, Room Temperature and setpoint, Face and Bypass damper, Economizer setpoint, Occupancy	
BA-AH2	SF-S, Cooling Valve, Heating Output, DAT and setpoint, MAT, RAT, EAT, Heat Recovery Temp, OAT, Mixed Air damper Position, Electric Duct Heat, Room Temperature and setpoint, Face and Bypass damper, Economizer setpoint, Occupancy	
AHU-1	SF-S, F&B Damper Pos, Zone Temp and setpoint	
AHU-2	SF-S and speed, EF-S and speed, DAT and setpoint, OA Damper Pos and min pos, Heating Output, Cooling Valve Pos, DSP and setpoint, MAT, RAT, Space Static and setpoint, Avg Zone Temp	
VAVs	Heating Valve Position, Flow and setpoint, Damper Position, Zone Temp and setpoint. Some has CO2 and/or Baseboard heat.	
AHU-3 AHU-4	SF-S and speed, EF-S and speed, DAT and setpoint, OA Damper Pos and min pos, Heating Output, Cooling Valve Pos, Humidification Valve Pos, DSP and setpoint, MAT, RAT, Space Static and setpoint, Zone Temp, RH and setpoint (4X)	
AHU-5	SF-S, Heating Valve Pos, Cooling Valve Pos, Reheat Valve Pos, Humidification Valve Pos, OA Damper Pos and min pos, MAT, RAT, Zone Temp and setpoint, Zone RH and setpoint,	
AHU-6	SF-S, EF-S, Heating Output, Wheel Status, DAT and setpoint, RAT, EAT, OAT, Zone Temp and setpoint, Zone RH and setpoint,	
Boiler1 Boiler2	B1-S, B2-S, HW Pump status, HWST and setpoint, HWRT, HWRT Low Limit, OAT, OA Enable Setpoint,	
CHW	CHW Pump Status and speed, Flow, CHWST, CHWRT, Heat Tape Status	
Radiation	Nine (9) zones of radiation with temp and setpoint and status	

Charter Hall State ID# E26075S0670					
Area (sq.ft.)	55,618	Year Built	1970	Occupancy (hrs/yr)	5,096

HVAC Equipment

Name	Type	Size	Notes
C-AH1	Dual Duct Constant Volume		
C-AH2	Dual Duct Constant Volume		
C-AH12	Constant Volume		
C-AH13	Constant Volume		
Boilers	Electric Boiler	240kW (2X)	Two boilers

Notes

Charter Hall consists of classrooms, two lecture halls and four computer labs.

Points on BAS

Name	List of Points	Notes
C-AH1 C-AH2	SF-S, RF-S, Heating Valve, Humidifier Valve, Cold Deck Temp and setpoint, Hot Deck Temp and setpoint, MAT, RAT, RARH, OAT, OA damper Position, Economizer setpoint, Night setback setpoint, Occupancy	2 Identical Units
C-AH3 C-AH4	SF-S, RF-S, Heating Valve, Cooling Valve, Humidifier Valve, DAT and setpoint, MAT, RAT, RARH, OAT, OA damper Position and min pos, Economizer setpoint, Night setback setpoint, Occupancy	2 Identical Units
Boilers	HW Pump Status, Electric Boiler Heat (%), HWST and setpoint, HWRT, OAT, Reset schedule	
CHW	CHWST and setpoint, CHWRT, CHW Flow, CHW Valve	

Commons East State ID# E26075S5670					
Area (sq.ft.)	5,363	Year Built	1970	Occupancy (hrs/yr)	8,760

HVAC Equipment

Name	Type	Size	Notes
AHU-1	Constant Volume		Hot Water Heat, No Cool
AHU-2	Constant Volume		Hot Water Heat, No Cool

Notes

Commons East is a place for students to get household equipment, get their mail and do laundry.

Points on BAS

Name	List of Points	Notes
AHUs	SF Status, DAT, Heating Valve Position, Room Temp	Both AHUs are identical.

Conference Center	State ID# E26075S5970				
Area (sq.ft.)	31,989	Year Built	1970/96/2005	Occupancy (hrs/yr)	5,460

HVAC Equipment

Name	**Type**	**Size**	**Notes**
AHU-1	Constant Volume		
AHU-2	Constant Volume		
AHU-3	Constant Volume		
AHU-4	Constant Volume		

Notes

The Conference Center is used for exactly what it sounds like; conferences and events.

Points on BAS

Name	**List of Points**	**Notes**
AHU-1 AHU-2 AHU-3	SF-S, Heating Output, Cooling Valve Pos, OA Damper pos and min pos, DAT and setpoint, RAT, RARH, MAT, OAT, Economizer setpoint, Zone Temp and setpoint	Three identical units
AHU-4	SF-S, Heating Output (2X), Cooling Valve Pos, OA Damper pos and min pos, DAT and setpoint, RAT, RARH, MAT, OAT, Economizer setpoint, Building Static Pressure and setpoint, In-floor Heat Valve Pos, Zone Temp and setpoint	

Fine Arts State ID# E26075S0268					
Area (sq.ft.)	57,650	Year Built	1968	Occupancy (hrs/yr)	3,900

HVAC Equipment

Name	Type	Size	Notes
FA-AH1	Dual Duct Constant Volume		
FA-AH2	Dual Duct Constant Volume		
FA-AH3	Dual Duct Constant Volume		
FA-AH4	Dual Duct Constant Volume		
FA-AH5	Dual Duct Constant Volume		
FA-AH6	Energy Recovery Unit 100%OA		
FA-AH7	Dual Duct Constant Volume		

Notes

The Fine Arts building houses the band and choir rooms, two theatres, and rehearsal rooms.

Points on BAS

Name	List of Points	Notes
FA-AH1 FA-AH2 FA-AH3 FA-AH4 FA-AH5 FA-AH7	SF-S, RF-S, OA Damper Pos and min pos, Hot Deck Temp and setpoint, Cold Deck Temp and setpoint, RAT, MAT, OAT, Economizer setpoint, Occupancy	6 Identical Units
FA-AH6	SF-S, EF1-S, EF2-S, Heat Recovery Status, Electric Duct heat Output, HR IN-T, HR OUT-T, HR Setpoint, DAT and setpoint, OAT, Occupancy	
CHW	CHWP8-S, CHW Flow, CHW Valve Pos, CHWST, CHWRT and setpoint, Heat Tape Status (2X)	

Founders Hall State ID# E26075S1073					
Area (sq.ft.)	33,400	Year Built	1973	Occupancy (hrs/yr)	2,600

HVAC Equipment

Name	Type	Size	Notes
FA-AH1	Constant Volume		
FA-AH2	Constant Volume		DX Cooling
FA-AH3	Constant Volume		

Notes

Founders Hall is the main office for the campus.

Points on BAS

Name	List of Points	Notes
FA-AH1 FA-AH3	SF-S, Cooling Valve Pos, Humidifier Valve Pos, OA Damper Pos and min pos, DAT and setpoint, RAT, RARH and setpoint, MAT, OAT, Economizer setpoint, Room Temp, Occupancy	2 Identical Units
FA-AH2	SF-S, Heating Output, DX Stage 1 and 2, Humidifier Valve Pos, OA Damper Pos and min pos, DAT and setpoint, RAT, RARH and setpoint, MAT, OAT, Economizer setpoint, Room Temp, Occupancy	
Snow Melt	Status, Circuit Status (2X)	

HA Complex State ID# E26075S5770					
Area (sq.ft.)	43,167	Year Built	1970	Occupancy (hrs/yr)	6,552*

HVAC Equipment

Name	Type	Size	Notes
HA-Fan-1	Constant Volume	30 kW Heat	
HA-Fan-2	Constant Volume	30 kW Heat	
HA-Fan-3	Constant Volume	30 kW Heat	
HA-Fan-4	Constant Volume	30 kW Heat	

Notes

This building is a residence hall with simple HVAC and no cooling.

*This building is closed over the summer, but otherwise operated 24/7.

Points on BAS

Name	List of Points	Notes
HA-Fans	SF-S, Occupied, DH-S, Stages of Heat (7), DAT, Zone Occupied and Unoccupied setpoint	4 Identical Units

Central plant in Maintenance Building State ID# E260750570					
Area (sq.ft.)	12,500	Year Built	1970/2007	Occupancy (hrs/yr)	2,340

HVAC Equipment

Name	**Type**	**Size**	**Notes**
Cooling Tower 1			Takes Care of Chiller 1
Cooling Tower 2			Takes Care of Chiller 2
Chiller 1	Centrifugal	750 Ton	Chiller 1 and 2 are in parallel. Main chillers for campus CHW Loop.
Chiller 2	Centrifugal	750 Ton	

Points on BAS

Name	**List of Points**	**Notes**
Cooling Tower 1 Cooling Tower 2	Status, CT LWT, CT EWT, CT Flow, CT Pump Status, OAT	
Chiller 1	CHLR1-S	
Chiller 2	CHLR2-S	
CHW Loop	CHWST and setpoint, CHWRT, CHW Flow, CHW Pump Status and Speed (2X), CHW-DP and setpoint, CHW System Enable Temperature, OAT, CHW Temps for all buildings	
Demand Limiting	A full list of all the HVAC equipment with their motor status building by building.	Used to manually shed demand when approaching the WAPA demand limits.

Physical Education	State ID# E26075S0368				
Area (sq.ft.)	98,764	Year Built	1968/70	Occupancy (hrs/yr)	5,460*

HVAC Equipment

Name	Type	Size	Notes
PE-AH1	Dual Duct Constant Volume		Serves Offices
PE-AH2	Constant Volume		Serves Gym
PE-AH3	Constant Volume		Serves Locker Rooms
PE-AH4	Heat Recovery CV		
PE-AH5	Constant Volume		Small unit serving Concession area
PE-AH6	Constant Volume		Serves Concession area
PE-AH7	Constant Volume		Serves Racquetball Court
PE-AH8	Constant Volume		Serves Pool
PE-AH9	Constant Volume		Serves Pool
Pool Heater	Electric Boiler	140kW	

Notes

The PE Building has a gym, a pool, and classrooms. The gym and pool area is open 5,460 hours per year, and the classrooms 3,900 hours per year.

Points on BAS

Name	List of Points	Notes
PE-AH1	SF-S, Heat Output, Cooling Valve Pos, OA Damper pos, Hot Deck Temp and setpoint, Cold Deck Temp, RAT, MAT, Occupancy, Room Temperature	
PE-AH2	SF-S, Heat Output, OA Damper pos and min pos, Economizer setpoint, DAT and setpoint, RAT, MAT, Occupancy, Room Temperature and setpoint	
PE-AH3	SF-S, Heat Output (2X), OA Damper pos and min pos, MAT and setpoint, RAT, Occupancy, Room Temperature and setpoint	
PE-AH4	SF-S, EF-S, Heat Recovery Status, DAT, RAT, EAT, HR Setpoint, Occupancy	
PE-AH5	SF-S	
PE-AH6	SF-S, Heating Output, Room Temperature and setpoint	
PE-AH7 PE-AH9	SF-S, RF-S, Heat Output, OA Damper pos and min pos, DAT and setpoint, RAT, MAT, Occupancy, Room Temperature and setpoint	
PE-AH8	SF-S, EF-S, Heat Output, DAT1, DAT2, EAT, OAT, Occupancy, Heat Recovery Pump Status, Room Temperature and setpoint, Room Humidity	
Pool Heaters	Heater Status, Pump Status, Water Temperature	

Recreation/Athletic Facility	State ID# E26075S1295				
Area (sq.ft.)	71,033	Year Built	1995	Occupancy (hrs/yr)	5,460

HVAC Equipment

Name	Type	Size	Notes
RA-AHU-1	Heat Recovery CV	1,700kW Heat	
RA-AHU-2	Constant Volume	10hp, 60kW Heat	Small unit serving one room
RA-AHU-3	Constant Volume	3hp, 15kW Heat	Small unit serving one room
RA-AHU-4	Constant Volume	7.5hp, 35kW Heat	Small unit serving one room
RA-AHU-5	Constant Volume		Small unit serving one room
RA-AHU-6	Constant Volume		Small unit serving one room
RA-AHU-7	Constant Volume		Small unit serving one room
RA-AHU-8	Constant Volume		Small unit serving one room
RA-AHU-9	Constant Volume		Small unit serving one room
RA-MAH-1	100% OA MAU	560kW Heat	

Notes

The R/A has a fitness center, weight room, and smaller group rooms.

Points on BAS

Name	List of Points	Notes
RA-AHU-1	SF1-S, SF2-S, RF-S, HR Pump Status, Heating Output, OA Damper Pos, RACO2, DAT, RAT, MAT, EAT, OAT, Outdoor Coil In Temp, Outdoor Coil Out Temp, Occupancy, Avg Room Temp, Room Temp (4X), Room Setpoint	
RA-AHU-2 RA-AHU-3 RA-AHU-4 RA-AHU-5 RA-AHU-7 RA-AHU-8	SF-S, Heat Output, Duct Heat Output, MA Damper Pos, RAT, RACO2 and setpoint, MAT, DAT, Occ, Flow and setpoint, Room Temp and setpoint, Economizer setpoint	
RA-AHU-6	SF-S, Cooling Valve Pos, Duct Heat Output, MA Damper Pos, RAT, RACO2 and setpoint, MAT, DAT, EAT, VAV Occ, VAV Flow and setpoint, Room Temp and setpoint, Economizer setpoint, CHWST, CHWRT, CHW Pump Status	
RA-AHU-9	SF-S, Cooling Valve Pos, Duct Heat Output, MA Damper Pos, RAT, RACO2 and setpoint, MAT, DAT, EAT, Occ, Flows and setpoints, Room Temp and setpoint, Economizer setpoint, CHWST, CHWRT, CHW Pump Status	
RA-MAU-1	SF1-S, HR Pump Status, Duct Heat Output, DAT and setpoint, RAT, MAT, EAT, OAT, HR Coil In and Out Temp, DSP and setpoint, Occupancy	
RA-CHW	CHW Pump-S, CHWST, CHWRT, Heat Tamp Status (3)	

Science & Technology			State ID# E26075S0470		
Area (sq.ft.)	70,285	Year Built	1970	Occupancy (hrs/yr)	3,900

HVAC Equipment

Name	Type	Size	Notes
AH1	Dual Duct Constant Volume		
AH2	Dual Duct Constant Volume	20hp	
AH4	Constant Volume		
AH5	Constant Volume	698kW Heat	
400T Chiller	Chiller – Air-Cooled	400 Ton	Part of campus CHW Loop. Not dedicated to this building, just located by it.

Notes

Science & Technology consists of classrooms and labs.

Points on BAS

Name	List of Points	Notes
AH-1	SF-S, Cooling Valve Pos, Heating Output, Humidification Valve Pos, Cold Deck Temp and setpoint, Hot Deck Temp and setpoint, RAT, MAT, OAT, Damper position and min position, Economizer Setpoint, Humidity Setpoint, Occupancy,	
AH-2	SF-S, Cooling Valve Pos, Heating Output, Return Air Heating Output, Humidification Valve Pos, Cold Deck Temp and setpoint, Hot Deck Temp and setpoint, RAT, RARH, MAT and setpoint, OAT, Damper position and min position, Economizer Setpoint, Humidity Setpoint, Occupancy	
AH-4 AH-5	SF-S, EF-S, FBP/Cooling Damper Position, Heating Output, DAT and setpoint, RAT, MAT, OAT, Damper position and min position, Economizer Setpoint, Room temperature and heating and cooling setpoints, Occupancy	
CHW	CHW Flow, CHW Valve, CHWST, CHWRT and setpoint, Heat Tape Status (2X)	
400T Chiller	Chiller Status, Chiller Full Load Amps %, Chiller Flow, Pump Status and speed, CHWST and setpoint, CHWRT, Compressor Status (4X), Condenser Fan Speed (2X), Evaporator Temp (2X), Demand Limit (%)	

Social Science State ID# E26075S1173					
Area (sq.ft.)	53,350	Year Built	1973	Occupancy (hrs/yr)	3,900

HVAC Equipment

Name	Type	Size	Notes
AH-1	VAV with Heat Recovery	16kW Heat	
AH-2	VAV	28 kW Heat	
AH-3	VAV with Heat Recovery	15 kW Heat	
CHLR1	Chiller – Air-cooled	150 Ton	Not in use.

Notes

The Social Science building has classrooms, and a small museum.

Points on BAS

Name	List of Points	Notes
AH-1 AH-3	SF-S, RF-S, Heat Recovery Status, Heat Wheel Status and Speed (Intake and Exhaust Wheels), Preheat Output (%), Heating Output (%), Cooling Valve Pos, DAT and setpoint, RAT, Preheat Temp, MAT, OAT, EAT, High Room CO2, DSP, OA Flow, Space Static Pressure, OA Damper position and min position, RA Damper Position and min position, Occupancy, Winter/Summer Switchover setpoint	
AH-2	SF-S, RF-S, Heating Output (%), Cooling Valve Pos, DAT and setpoint, RAT, MAT, OAT, EAT, RACO2, DSP, OA Flow, Space Static Pressure, OA Damper position, RA Damper Position, Occupancy, Winter/Summer Switchover setpoint	
CHLR1	Status, Water Flow, Pump control, Pump Status, CHWST, CHWRT, CHWS Pressure, CHWR Pressure,	
Chilled Water	Chiller Status, Pump Status, Compressor 1 Status, Compressor 2 Status, Pump VFD Speed, CHWST and setpoint, CHWRT, Plant CHWST, Plant CHWRT, Condenser Fan 1 Speed, Condenser Fan 2 Speed, Loop DP and setpoint, Demand Limit (%)	
CHW Heat Trace	Heat Tape Status (2X)	
CO2	All room CO2 Levels (26 Rooms)	

Student Center State ID# E26075S8073					
Area (sq.ft.)	76,940	Year Built	1970/2005	Occupancy (hrs/yr)	5,460

HVAC Equipment

Name	**Type**	**Size**	**Notes**
AHU-1	VAV	30hp, 575 kW Heat	49 VAVs
AHU-2	VAV	25hp, 175 kW Heat	18 VAVs
Boiler 1	Electric Boiler	225kW	
Boiler 2	Electric Boiler	225kW	
EX Fans			5 Units
CUHs			7 Units

Notes

The Student Center is the hub for SMSU students. It has the main dining hall, a coffee shop, book store, and various offices.

Points on BAS

Name	**List of Points**	**Notes**
AHU-1 AHU-2	SFA-S and speed, SFB-S and speed, RF-S and speed, DAT and setpoint, DSP and setpoint, Heat Output, Cooling Valve Pos, OA Damper Pos, MAT,RAT, RARH, OAT, SF-Flow, RF-Flow, Economizer Setpoint	
Boilers	System Enable, BLR1-S, BLR1-Output (%), BLR1-HWST, BLR1-HWRT, BLR2-S, BLR2-Output (%), BLR2-HWST, BLR2-HWRT, HWST and setpoint, HWRT, HW Pump 1-S, HW Pump 2-S, HW Pump 3-S, HW Pump 4-S, Floor Heat Valve Pos, Snow Melt Status,	
CHW	CHW-Enable, CHW Pump (2-4) Status, CHW Pump 5 Status and speed, CHWDP and setpoint, CHWST, CHWRT, CHW Valve(A-C) Position,	

Consider for Investigation:

There are eleven buildings, two of the commons, six dorms, Individualized Learning, Regional Event Center, and Science & Math, that should be considered for investigation by SMSU. The eleven buildings have a total of 434,799 interior square feet. While some of these buildings are large, they are currently under construction. The other buildings have a small floor area, no cooling, or little to no control on the BAS. The screening information was collected from site visits, interviews, mechanical prints, and past energy studies.

Mechanical Equipment Summary Table	
1	Johnson Controls Metasys 4 Automation System
11	Buildings
434,799	Square Feet
39	Air Handlers
93	Terminal Units
1	Electric Hot Water Boilers
2	Natural Gas Hot Water Boiler

Commons Central State ID# E26075S5168

Area (sq.ft.)	5,746	Year Built	1968	Occupancy (hrs/yr)	8,760

HVAC Equipment

- **AHU**

Name	Type	Size	Notes
AHU-1	Constant Volume	47.5 kW Heat	7 Stages of Heat, No Cool
AHU-2	Constant Volume	47.5 kW Heat	7 Stages of Heat, No Cool

Notes

This building is small and has very simple HVAC and no cooling.

Points on BAS

Name	List of Points	Notes
AHUs	SF Status, DAT, Stages of Heat (7), Room Temp, Day and Night Setback and setpoint.	Both AHUs are identical.

Commons West State ID# E26075S6170					
Area (sq.ft.)	5,363	Year Built	1970	Occupancy (hrs/yr)	8,760

HVAC Equipment

Name	Type	Size	Notes
Fan 1	Constant Volume	30 kW Heat	Serves Office. Has Electric Duct Heater
Fan 2	Constant Volume	17.5 kW Heat	Serves Lounge. Has Electric Duct Heater

Notes

This building is small and has very simple HVAC and no cooling.

Points on BAS

Name	List of Points	Notes
All	Fan 1 Status, Fan 2 Status, EDH1 Status, EDH2 Status	All were offline.

G Residence Hall State ID# E26075S5469					
Area (sq.ft.)	38,792	Year Built	1969	Occupancy (hrs/yr)	6,552*

HVAC Equipment

Name	Type	Size	Notes
G-Fan-1	Constant Volume	30 kW Heat	
G-Fan-2	Constant Volume	30 kW Heat	
G-Fan-3	Constant Volume	30 kW Heat	
G-Fan-4	Constant Volume	30 kW Heat	

Notes

This building is large but has very simple HVAC and no cooling.

*This building is closed over the summer.

Points on BAS

Name	List of Points	Notes
G-Fans	SF-S, Occupied, DH-S, Stages of Heat (7), DAT	4 Identical Units

GM Residence Hall	State ID# E26075S5268				
Area (sq.ft.)	38,478	Year Built	1968	Occupancy (hrs/yr)	6,552*

HVAC Equipment

Name	Type	Size	Notes
GM-Fan-1	Constant Volume	30 kW Heat	
GM-Fan-2	Constant Volume	30 kW Heat	
GM-Fan-3	Constant Volume	30 kW Heat	
GM-Fan-4	Constant Volume	24 kW Heat	

Notes

This building is large but has very simple HVAC and no cooling.
*This building is closed over the summer.

Points on BAS

Name	List of Points	Notes
GM-Fan-1	SF-S, Preheat-S, Heat-S, Preheat DAT, DAT, Room Temp	
GM-Fan-2-4	SF-S, Occupied, DH-S, Stages of Heat (7), DAT, Zone Occupied and Unoccupied setpoint	3 Identical Units

GW Residence Hall	State ID# E26075S5368				
Area (sq.ft.)	40,100	Year Built	1968	Occupancy (hrs/yr)	6,552*

HVAC Equipment

Name	Type	Size	Notes
GW-Fan-1	Constant Volume	63 kW Heat total	
GW-Fan-2	Constant Volume		
GW-Fan-3	Constant Volume		
GW-Fan-4	Constant Volume		

Notes

This building is large but has very simple HVAC and no cooling.
*This building is closed over the summer.

Points on BAS

Name	List of Points	Notes
GW-Fans	Occupied-S, SF-S and Speed, EF-S and Speed, Electric Heat Output (%), Zone temp, day and night setpoints, DAT, MAT	4 Identical Units

HB Residence Hall	State ID# E26075S6070				
Area (sq.ft.)	38,478	Year Built	1970	Occupancy (hrs/yr)	6,552*

HVAC Equipment

Name	Type	Size	Notes
HB-Fan-1	Constant Volume	30 kW Heat	
HB-Fan-2	Constant Volume	30 kW Heat	
HB-Fan-3	Constant Volume	30 kW Heat	
HB-Fan-4	Constant Volume	30 kW Heat	

Notes

This building is large but has very simple HVAC and no cooling.

*This building is closed over the summer.

Points on BAS

Name	List of Points	Notes
HB-Fans	SF-S, Occupied, DH-S, Stages of Heat (7), DAT, Zone Occupied and Unoccupied setpoint	4 Identical Units

HC Residence Hall	State ID# E26075S5870				
Area (sq.ft.)	39,922	Year Built	1970	Occupancy (hrs/yr)	6,552*

HVAC Equipment

Name	Type	Size	Notes
HC-Fan-1	Constant Volume	30 kW Heat	
HC-Fan-2	Constant Volume	30 kW Heat	
HC-Fan-3	Constant Volume	30 kW Heat	
HC-Fan-4	Constant Volume	30 kW Heat	

Notes

This building is large but has very simple HVAC and no cooling.

*This building is closed over the summer.

Points on BAS

Name	List of Points	Notes
HC-Fans	SF-S, Occupied, DH-S, Stages of Heat (7), DAT, Zone Occupied and Unoccupied setpoint	4 Identical Units

Individualized Learning State ID# E26075S0872					
Area (sq.ft.)	61,560	Year Built	1972	Occupancy (hrs/yr)	3,900

HVAC Equipment

Name	Type	Size	Notes
IL-AH1	Constant Volume		Duct Reheats in spaces
IL-AH2	Constant Volume		Duct Reheats in spaces
IL-AH3	Constant Volume	10hp	Duct Reheats in spaces
IL-AH4	Constant Volume	7.5hp	New fan. Duct Reheats in spaces
IL-AH5	Constant Volume	7.5hp	New fan. Duct Reheats in spaces

Notes

This building is large but the south pod is under construction, completion date in August 2010.

Points on BAS

Name	List of Points	Notes
IL-AHs	SF-S, Cooling Valve Pos, OA Damper pos and min pos, Economizer setpoint, DAT and setpoint, RAT, RARH, MAT, Occupancy,	AH1 has 4 EF-S. AH3 has 4 EF-S.
CHW	CHWP-S (3X), CHWST, CHWRT and setpoint, CHW Flow, CHW Valve Pos, Heat Tape Status (4X)	Building is divided into North, South, and East. Each has own controls.

Regional Event Center State ID# E26075S8009					
Area (sq.ft.)	24,700	Year Built	2008	Occupancy (hrs/yr)	3,640*

HVAC Equipment

Name	Type	Size	Notes
FCU	Fan Coil Unit (4-Pipe)	20 Units	HW and CHW
UH	Unit Heater	23 Units	
EF	Exhaust Fan	8 Units	
FTR	Fin Tube Radiation	2 Areas	Electric
RACU	Room AC Unit	1 Unit	

Notes

This building is large but has no BAS control. The temperatures are only monitored.

*This building is closed over the summer.

Points on BAS

Name	List of Points	Notes
Floor plans	Room temperatures, FCU, UH, EF, FTR, RACU Locations	Lower and Upper Levels
CHW	Pump-S and speed, CHWST, CHWRT, CHWDP, CHW Flow	

Science & Math	State ID# E26075S0772				
Area (sq.ft.)	74,060	Year Built	1972	Occupancy (hrs/yr)	3,900

HVAC Equipment

Name	Type	Size	Notes
AH-1	Constant Volume AHU	20hp SF, 10hp RF	Serves Animal Room
AH-2	Constant Volume AHU	20hp SF, 10hp RF	Serves 1st Floor Interior W
AH-3	Constant Volume AHU	20hp SF, 10hp RF	Serves 1st Floor Interior E
AH-4	Constant Volume AHU	20hp SF, 10hp RF	Serves Planetarium & Museum
AH-5	Constant Volume AHU	20hp SF, 10hp RF	Serves 2nd Floor Interior W
AH-6	Constant Volume AHU	20hp SF, 10hp RF	Serves 2nd Floor Interior E
AH-7	Constant Volume AHU	20hp SF, 10hp RF	Serves All Perimeter
AH-8	Constant Volume AHU		Serves Electrical Room in Basement
BLR2	Electric Boiler		Serves Greenhouse

Notes

This building is large but two new AHUs are being installed, finished in December 2010.

Points on BAS

Name	List of Points	Notes
AH-1	SF-S, RF-S, Compressor Fan Status, Condenser Fan Status, Heating Command (%), Cooling Command (%), Preheat (%), Duct Heater (%), Humidification (%), DAT, Room temperature and setpoint, Room Humidity, Preheat temp, OAT, Occupancy	
AH-2 AH-3 AH-5 AH-7	SF-S, RF-S, Cooling Valve Pos, Heating Valve Pos, Humidification Valve Pos, DAT and setpoint, RAT, RARH, MAT, OAT, Damper position and min position, Economizer Setpoint, Room temperature and setpoint, Occupancy	
AH-4 AH-6	SF-S, RF-S, Cooling Valve Pos, Humidification Valve Pos, DAT and setpoint, RAT, RARH, MAT, OAT, Damper position and min position, Economizer Setpoint, Room temperature and setpoint, Occupancy	
AH-8	SF-S, RF-S, Damper Position and min position, DAT and setpoint, Room temperature, Boiler Enable Call	
CHW-PH	Heat Tape (1-4) Status, CHW Flow Meter, CHW Valve Pos, CHWST, CHWRT and setpoint,	Chilled Water Control for AHUs in penthouse.
BLR2	Boiler-S, HWST, HWRT, East Room Temp, West Room Temp	

Sweetland Hall State ID# E26075S8010					
Area (sq.ft.)	67,600	Year Built	2009	Occupancy (hrs/yr)	8,760

HVAC Equipment

Name	**Type**	**Size**	**Notes**
HRU-1	Heat Recovery Unit		
HRU-2	Heat Recovery Unit		
FCU	4-Pipe Fan Coil Unit	47 Units	One in each living unit. Cooling and Heating coils.
Boilers	Natural Gas Boilers	1,750kBtu/h (2x)	

Notes

This building is large but not controlled by the BAS. All terminal equipment is controlled by room thermostats. The building has been in use for less than one year.

Points on BAS

Name	**List of Points**	**Notes**
HRU-1 HRU-2	SF-S, EF-S, Wheel-S, OAT, HR Temp, DAT and setpoint, EAT, Wheel Air Temp, Preheat Pump-S, Preheat Valve Pos, Cooling Valve Pos, OAD Open/Closed	
Rooms	Temperature and setpoint	

Poor Candidates for Investigation:

Two buildings, the Child Care Center and Vehicle Storage Building, totaling 7,294 ft^2 listed below are not good candidates for investigation. The screening information was collected from site visits, interviews, mechanical prints, and past energy studies. These additional attributes support the decision to recommend the facility for recommissioning:

- The remaining buildings are small (totaling 7,294 square feet)
- Not on the Building Automation System
- Residential style HVAC systems.

Child Care Center State ID# E26075S1590					
Area (sq.ft.)	2,744	Year Built	1990	Occupancy (hrs/yr)	3,120
HVAC Equipment					
• **Not on BAS**					
Points on BAS					
• **Not on BAS**					

Vehicle Storage Building State ID# E26075S1606					
Area (sq.ft.)	4,550	Year Built	2005	Occupancy (hrs/yr)	2,080
HVAC Equipment					
• **Not on BAS**					
Points on BAS					
• **Not on BAS**					

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HW	Hot Water
BAS	Building Automation System	HWDP	Hot Water Differential Pressure
CDW	Condenser Water	HWRT	Hot Water Return Temperature
CDWRT	Condenser Water Return Temperature	HWST	Hot Water Supply Temperature
CDWST	Condenser Water Supply Temperature	kW	Kilowatt
CFM	Cubic Feet per Minute	kWh	Kilowatt-hour
CHW	Chilled Water	MA	Mixed Air
CHWRT	Chilled Water Return Temperature	MA Enth	Mixed Air Enthalpy
CHWDP	Chilled Water Differential Pressure	MARH	Mixed Air Relative Humidity
CHWST	Chilled Water Supply Temperature	MAT	Mixed Air Temperature
CRAC	Computer Room Air Conditioner	MAU	Make-up Air Unit
CV	Constant Volume	OA	Outside Air
DA	Discharge Air	OA Enth	Outside Air Enthalpy
DA Enth	Discharge Air Enthalpy	OARH	Outside Air Relative Humidity
DARH	Discharge Air Relative Humidity	OAT	Outside Air Temperature
DAT	Discharge Air Temperature	Occ	Occupied
DDC	Direct Digital Control	PTAC	Packaged Terminal Air Conditioner
DP	Differential Pressure	RA	Return Air
DSP	Duct Static Pressure	RA Enth	Return Air Enthalpy
DX	Direct Expansion	RARH	Return Air Relative Humidity
EA	Exhaust Air	RAT	Return Air Temperature
EAT	Exhaust Air Temperature	RF	Return Fan
Econ	Economizer	RH	Relative Humidity
EF	Exhaust Fan	RTU	Rooftop Unit
Enth	Enthalpy	-S	Status
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
HP	Horsepower	VFD	Variable Frequency Drive
HRU	Heat Recovery Unit	VIGV	Variable Inlet Guide Vanes

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH